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Conservation Assessment—Henslow's Sparrow *Ammodramus henslowii*

Dirk E. Burhans

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Conservation Assessment—
Henslow's Sparrow *Ammodramus henslowii*

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SUMMARY

Apparent population declines of migrant songbirds have resulted in special interest in grassland songbirds, which show some of the most consistent declines among songbirds generally. Among these species, Henslow's Sparrows have the most restrictive habitat requirements and show some of the most serious declines. The Henslow's Sparrow is often overlooked due to its shy, secretive nature and nondescript song. In the Midwest, Henslow's Sparrows historically bred in native tallgrass prairie habitat; in the East, grasslands maintained by natural disturbances or fires set by Native Americans provided habitat for birds like Henslow's Sparrow. Henslow's Sparrows were probably numerous in the Midwest before European settlement and the transition to large-scale grassland development. Declines in the Midwest are largely due to loss of tallgrass habitat; estimates of the tallgrass prairie lost range as high as 99.9 percent. Declines in the East may be due to reforestation and loss of pastures. In addition to loss of prairies and native grasslands throughout the Henslow's Sparrow's range, intensive human use of "secondary grasslands"—hayfields and pastures that contribute to the grassland landscape—has also contributed to habitat decline.

Henslow's Sparrows use grassland habitats. Grasslands that provide breeding habitat for Henslow's Sparrow need to be large (generally >30 ha), have a well-developed layer of litter, and contain standing dead vegetation. Some woody shrubs will be used as song perches, but too many shrubs, such as in an old field, will result in unsuitable habitat. Wintering habitats used by Henslow's Sparrow may be much smaller (sometimes <1.0 ha) and may not require litter and standing dead vegetation. With the possible exception of reclaimed strip mines, both wintering and breeding habitats require frequent disturbance, such as fire, grazing, or mowing, to maintain suitability for Henslow's Sparrows. Henslow's Sparrows will not occupy these habitats immediately following severe disturbance, so that in some cases maintaining a desirable tract requires a "mosaic" of recently and not so recently (2-4 years) disturbed habitat parcels. Other recent studies suggest that light to moderate levels of grazing will maintain proper habitat structure throughout an entire tract. Where patches of grassland habitat adjoin one another, removal of fencerows and treelines between patches may facilitate occupancy of smaller breeding habitats.

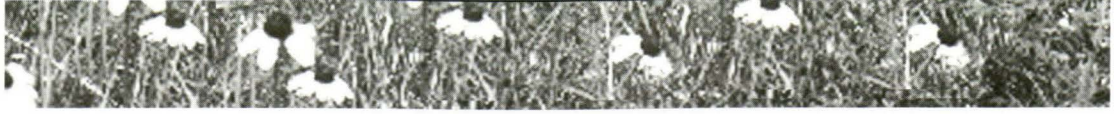
Publicly owned grasslands on both the breeding and wintering grounds, particularly at some U.S. Army installations and National and State Wildlife Refuges, comprise significant habitats having large Henslow's Sparrow populations; yet many significant breeding populations are also found on privately owned lands, including reclaimed strip mines, pastures, hayfields, and Conservation Reserve Program (CRP) lands. The future of sparrow populations on private lands is not assured, particularly with declines in dairy farming, increases in intensive grazing, and row cropping of former hayfields. Studies on use of CRP land indicate that this land may provide appropriate Henslow's Sparrow habitat, but continuance of the program and management of grassland succession under CRP are not assured.

Present population surveys using Breeding Bird Survey (BBS) routes do not appear well suited for monitoring the species because of the ephemeral nature of Henslow's Sparrow habitat and because the surveys miss some significant populations. Future research needs to more adequately survey and monitor populations so that potential declines or increases can be accurately assessed. Although

much new information on breeding and wintering populations of Henslow's Sparrow has been acquired since Pruitt's 1996 report, more information is needed to determine the extent and viability of populations. Additional data are required on locations of breeding populations and nesting success across a range of fragment sizes; wintering site fidelity, habitat use, and site locations; and management approaches for both wintering and breeding habitat. The above data, when combined with reliable population survey data, will provide a more accurate assessment of how stable the Henslow's Sparrow population is and where or when management should intervene.

Maiken Winter

Treaty Line Prairie is a 64 ha prairie with breeding Henslow's Sparrows in southwestern Missouri.



Introduction and Background

The goal of this report is to provide information for the Southern Tier National Forests (Hoosier National Forest, Indiana; Shawnee National Forest, Illinois; Mark Twain National Forest, Missouri; Wayne National Forest, Ohio) and the Green Mountain and Finger Lakes National Forests (Vermont and New York, respectively) for addressing public concern about the status, distribution, and effects of proposed management practices on Henslow's Sparrow. Currently, Henslow's Sparrow is considered a Regional Forester Sensitive Species for the Mark Twain, Shawnee, Hoosier, Wayne, and Finger Lakes National Forests. The Regional Forester listing affords protection to a species on the National Forest where listed. The Forest's goal is to protect and improve habitat for the species where management practices warrant consideration of special habitat needs, and to ensure that it does not become threatened or endangered.

Several comprehensive reviews on the status, biology, and management of Henslow's Sparrow have already been completed (Austen *et al.* 1997, Hands *et al.* 1989, Herkert 1998, Pruitt 1996, Smith 1992). Pruitt's (1996) Status Assessment for the Fish and Wildlife Service was a particularly complete account of the information known about Henslow's Sparrow up to that time. In addition, a new series of Bird Conservation Plans from Partners in Flight employs a prioritization scheme for all bird species in each physiographic area and/or State in the United States as part of a long-term strategy for bird conservation (Carter *et al.* 2000). Many of these plans have been completed, and many include conservation strategies for grassland birds such as Henslow's Sparrow.

The present assessment repeats much of the information on biology, natural history, and habitat found in the documents above but also incorporates recent research in these areas. Because of the proximity of these States to the Hoosier, Mark Twain, Shawnee, Wayne, and Green Mountain/Finger Lakes National Forests, this assessment focuses particularly on Missouri, Illinois, Indiana, Ohio, New York, and Vermont. With the possible exception of Vermont, all of these States are particularly relevant to the status of Henslow's Sparrow because they are sources of recent research and information, much of it on newly discovered populations. To avoid redundancy with Pruitt's (1996) assessment, State summaries and land ownership summaries focus only on the above States, but information from new studies in additional States not reported in Pruitt (1996) is also included.

In her 1996 document, Pruitt listed the following needs for future research and monitoring: (1) monitoring of large breeding populations; (2) redesigning of breeding surveys to account for the ephemeral nature of Henslow's Sparrow breeding habitat; (3) further research into the ecology of Henslow's Sparrows on the wintering range, and (4) further research on the demography of Henslow's Sparrows. Since then, there have been advances in several of these areas. In particular, new breeding research has focused on several large breeding populations that were newly discovered or undiscovered at the time of Pruitt's (1996) assessment. This includes large breeding populations in reclaimed strip mines in southwestern Indiana; populations in reclaimed strip mines in southeastern Ohio; a breeding population that is large for the region at Fort Drum, New York; large populations at Fort Campbell in Kentucky and Tennessee, in reclaimed strip mines in Kentucky, and in public and private lands in southern Illinois.

Until recently, breeding assessments of Henslow's Sparrow consisted of densities or abundances of singing males and measurements of accompanying habitat features, without knowledge of reproductive success. Particularly gratifying has been the increase in nesting studies of this species, whose nests are notoriously difficult to find. These intensive nesting studies have shed light on valuable breeding information, particularly about daily survival estimates and numbers of broods, and have yielded more nests in the past 4 years than were known throughout the entire prior published history of the species. Whereas only one nesting study having

>10 nests had been completed at the time of Pruitt's (1996) assessment, now at least seven additional studies have been completed or are in progress (table 1).

In addition, several studies have been initiated or completed on the wintering grounds since 1996. Wintering areas supporting large populations, such as the Apalachicola National Forest in Florida, the Conecuh National Forest in Alabama, and the Mississippi Sandhill Crane National Wildlife Refuge, have also been sites for ongoing research on Henslow's Sparrow wintering ecology and management.

Table 1.—*Locations, nesting success, and sample sizes for Henslow's Sparrow nesting studies having ≥10 nests*

Location	Year(s)	Simple nesting success[a]	Mayfield nesting success[b]	Sample size (nests)	Author
		- - - *Percent* - - -			
Michigan	1966	54.5	NA	11	Robins 1971a
Northeastern Oklahoma	1992-1996	45.5	29	22	Reinking *et al.* in press
North-central Missouri	1997-1999	19.0	6.5	16	T. McCoy unpubl. data
Southwestern Missouri	1995-1997	57.6	39.5	59	Winter 1999
Tennessee	2000	42.9	18.7[c]	42	E.D. Moss unpubl. data
Kentucky	2000	74.2	NA	31	M. Monroe and G. Ritchison unpubl. data
Indiana	1998-2000	NA	NA	77	J. Robb unpubl. data
Indiana	1999-2000	42.9	33.3	21	S.L. Lima and E.W. Galligan unpubl. data

[a]Percent of nests fledging young/total active nests found.
[b]Calculated for the entire nesting period based on Mayfield (1975).
[c]Estimate based on 40 nests.

Taxonomy

Henslow's Sparrow belongs to the order Passeriformes, family Emberizidae, subfamily Emberizinae, genus *Ammodramus* (AOU 1998). It was formerly in the genus *Passerherbulus* (AOU 1957). Only one subspecies (*A. henslowii*) is currently recognized by the American Ornithologists' Union (AOU 1998).

An eastern subspecies was formerly recognized as *Passerherbulus henslowii susurrans* whose range extended from "central New York (Jefferson County, intergrading with *P. h. henslowii*), southern Vermont (Bennington), southern New Hampshire (Wonalancet), and northeastern Massachusetts (West Newbury) south to extreme western West Virginia (Morgan and Berkeley Counties), eastern Virginia (Lynchburg; Princess Anne County), and east-central North Carolina (Chapel Hill)" (Morgan and Berkeley Counties are in eastern West Virginia; from AOU 1957). However, it is not clear whether this was a true subspecies or if it is still extant (P. Vickery, pers. comm.). The subspecies status of a relatively recent population breeding in North Carolina also has not been determined (D.B. McNair, as cited in Pruitt 1996). Another subspecies, *A. h. houstonensis*, was proposed for Texas (Arnold 1983) but not accepted. Breeding populations of this bird have since been extirpated (C. Shackleford, pers. comm.).

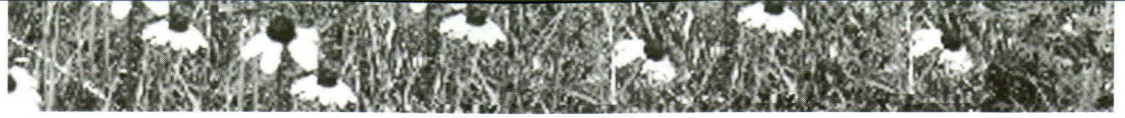
Description

Smith (1992) described the Henslow's Sparrow as "characterized by a large flat head, large gray bill, and short tail. The head, nape, and most of the central crown strip are olive-colored, with the wings extensively dark chestnut. The breast is finely streaked." The sexes are similar (Pyle *et al.* 1987).

The Henslow's Sparrow is often described as secretive, shy, elusive, and difficult to detect without its song (Andrle and Carroll 1988, Graber 1968, Melde and Koford 1996, Robins 1971a). Smith (1992) stated "when flushed, the bird flies low and jerkily, with a twisting motion of the tail" (see also Sutton 1959).

Maiken Winter

Prarie State Park is a 1,084 ha prairie in Barton County Missouri.



Range

Breeding Distribution

Breeding Henslow's Sparrows are found in Wisconsin and southern Minnesota west to central Kansas; south to northeastern Oklahoma and southern Missouri; southern Indiana and Illinois, northern and central Kentucky, and northern Tennessee; West Virginia to northern Virginia and Maryland; central and eastern North Carolina; north to northern New York; formerly to Vermont; west and north to Michigan, southern Ontario, and formerly to southern Quebec (Austen *et al.* 1997, Ellison 1992, Pruitt 1996, Smith 1992).

Non-breeding Range

Sibley and Monroe (1990) described the wintering range as "coastal States from South Carolina south to southern Florida, and west to Arkansas and southeastern Texas, casually north to Illinois, Indiana, and New England, and casually south to southern Texas." Henslow's Sparrows regularly winter in small numbers in the lower coastal plain of North Carolina as far north as Croatan National Forest (D.B. McNair, pers. comm.).

Biology/Natural History

Reproductive Biology and Phenology

Henslow's Sparrows are monogamous and territorial breeders (Graber 1968, Robins 1971a). They are frequently referred to as breeding in "colonies" (Hyde 1939, Graber 1968, Wiens 1969). Smith (1992) noted that "clumping" may be a more accurate description of Henslow's Sparrow territoriality, perhaps because suitable habitat is clumped. Mazur found that late arriving birds chose sites proximate to occupied sites, rather than larger suitable sites farther away, exhibiting "clustered occupancy" (Mazur 1996). Herkert (1994c) mentioned that Henslow's Sparrows also breed in single isolated pairs in Illinois grasslands.

Breeding males arrive on territory from March-April in central and southern portions of their range (Graber 1968, Smith 1968); average arrival dates extend into May for Minnesota, Nebraska, South Dakota (Graber 1968), and Missouri (Winter 1999). Sparrows depart in October. Zimmerman indicated a late occurrence of 31 October for a Henslow's Sparrow in Konza Prairie, Kansas (Zimmerman 1993).

Hyde (1939) indicated that first clutches are completed between 20 and 30 May depending upon latitude. The majority of clutch initiations were in the first 2 weeks of May for Winter's (1999) southwest Missouri population.

Nesting in Hyde's, Sutton's, and Robins' Michigan studies continued into middle or late August (Hyde 1939, Robins 1971a, Sutton 1959); Sutton (1959) believed that the young of late broods left nests as late as early September based on development of observed fledglings. The last fledging in a Kentucky study was 20 July (M. Monroe, unpublished data); Reinking *et al.* (in press) found two incubation stage nests in August in Oklahoma.

Territories and Nests

Territories in Robins' (1971a) study were maintained exclusively by song, but Sutton referred to frequent chasing between males (Sutton 1959). Henslow's Sparrow territories averaged 0.3 ha (n = 36) in Michigan (Robins 1971a) to 0.7 ha near Madison, Wisconsin (Wiens 1969). Robins (1971a) reported that territory size increased through summer, but Smith (1992) believed that this may have reflected movements of adults in response to dependent young.

Nests are frequently described as well concealed and difficult to find (Graber 1968, Pruitt 1996 and reference therein). Nests are usually built at the base of a grass clump and may have a portion that forms a partial dome over the cup (Hyde 1939). Early nests may be on the ground or in depressions in the ground (Hyde 1939); nests may be 5-50 cm above ground (Melde and Koford 1996, Winter 1999); each of four nests found by Skinner *et al.* (1984) was "several centimeters above the ground in a clump of grass." In Hyde's study, nests were sometimes attached to shrubs, particularly later in the breeding season when ambient vegetation was high (Hyde 1939). Winter's (1999) Henslow's Sparrow nests were never proximate to woody vegetation. Nests in areas burned in spring of the same year were placed within remaining big bluestem (*Andropogon gerardii*) or Indian grass (*Sorghastrum nutans*) clumps, whereas nests in unburned areas were placed in litter (Winter 1999). J. Robb (pers. comm.) described several nests placed in live green grass clumps in August and September following a spring burn in the same year.

All nests found by Robins in Michigan were resting upon litter near the ground, and only one was similar to the roofed nests described by Hyde (1939; Robins 1971a). Outer layers of nests are constructed of larger grasses and the cup interior is lined with finer grasses (Robins 1971a).

Number of Broods

Henslow's Sparrows are thought to raise two broods (Hyde 1939). Monroe and Richardson worked with a color-banded population in Kentucky and found nine pairs that raised second broods, two of which also raised a third brood (M. Monroe, pers. comm.). Robins (1971a) in Michigan indicated that Henslow's Sparrows could raise three broods per season, but he also believed that two broods were most common. Winter in Missouri referred to two "peaks of nest initiation," one in the third week of May and another in mid-June (Winter 1999).

Clutch Size

Robins' (1971a) most common clutch sizes were four to five eggs. Mean clutch size of Winter's Henslow's Sparrow unparasitized nests from southwestern Missouri (Winter 1999) was 3.8 ± 0.75 (SD; n = 56 nests). Average clutch size for Reinking *et al.*'s (in press) northeastern Oklahoma population was 3.3 eggs (n = 9). Mean clutch size in Kentucky was 3.53 ± 0.14 (SE; n = 30; M. Monroe, pers. comm.).

Incubation and Nestling Period

The incubation period starts with the laying of the last egg and lasts 11 days (Hyde 1939). Winter (1999) documented a single nest from building through hatching, for which incubation lasted 12 days.

The nestling period was 9.1 + 0.24 days (SD) for nine nests followed from hatching through fledging in Winter's study (Winter 1999). Hyde (1939) and Graber (1968) described the nestling period as lasting 9-10 days.

Nesting Success

Until recently, Robins' (1971a) study was the only one to quantitatively report nesting success for >10 nests. Table 1 indicates nesting success for his study and several recent studies; simple nesting success (number of nests fledged/number of nests found) ranges from 19 to 74 percent over seven studies for which data are available. The Mayfield nesting success estimate (Mayfield 1975) is a more reliable estimator of nesting success because it uses a daily survival estimate based on the number of days a nest is observed, and it can be sued to extrapolate this estimate for the entire nesting cycle. Mayfield nesting success ranges from 6.5 to 39.5 percent in those studies for which data are currently available (table 1).

Mortality and Predation Factors

Nest Predation

Predation was the main cause of nest failure in Winter's study, accounting for 86 percent of nest failures (Winter 1999). Robins observed a thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*) prey on an advanced nestling and believed that mammals and snakes were important predators (Robins 1971a). Hyde and Winter believed that snakes were important predators at sites in southern Michigan and southwestern Missouri, respectively (Hyde 1939, Winter 1999). In Pennsylvania, Henslow's Sparrows and their eggs constituted 12 percent of the diet of blue racers (*Coluber constrictor*) examined by Ruthven *et al.* (1928, as cited in Graber 1968).

Cowbird Parasitism

Henslow's Sparrows appear to be an infrequent cowbird host (Friedmann and Kiff 1985), having low to moderate parasitism frequencies. Winter (1999) reported parasitism frequencies of 5.3 percent (n = 56 nests); Robins reported one parasitized nest with two cowbird eggs out of 11 nests (Robins 1971a); Hyde (1939) had no instances of cowbird parasitism in his population; 1 of 78 Henslow's Sparrow nests was parasitized in a population in the Big Oaks National Wildlife Refuge in Indiana (J. Robb, unpublished data); a single cowbird egg was found in 1 of 37 active and inactive nests in Kentucky (M. Monroe, unpublished data); 8 percent (2 of 24) nests were parasitized in northeastern Oklahoma (Reinking *et al.*, in press); and 5 of 16 nests (31 percent) were parasitized in north-central Missouri (T. McCoy, unpublished data). Henslow's Sparrows are able to fledge young at parasitized nests, as two Henslow's Sparrow young fledged from one parasitized nest in Missouri (Winter 1999), and at least one sparrow young fledged from a parasitized nest in Oklahoma (Reinking *et al.*, in press).

Mowing and Disturbance

Mowing and haying or disturbance during active nesting appears to be a source of nest mortality (Graber 1968, Hyde 1939). Winter listed 3 of 59 Henslow's Sparrows nests as mowed (Winter 1999). Bollinger (1995) indicated that fields with early haying dates had lower sparrow densities and suggested that nest destruction was responsible. Kibbe and Laughlin (1985 and references therein) noted two mowed nests in Vermont. In New York, June mowing led to the abandonment of a hayfield by five territorial males (Smith 1992). In Illinois, CRP landowners sometimes mow during the middle of the breeding season instead of waiting until nesting has been completed (N. Harroff, pers. comm.).

The authors of a study on Henslow's Sparrows and other grassland birds nesting on Fort Drum, New York, suspected that many nests were crushed by troops or military vehicles during training (S. Joule, unpublished data). One radio-tagged Henslow's Sparrow at Fort Drum moved over 2 km to a new territory when his old territory was heavily impacted by tank maneuvers (R. Krebs, pers. comm.). Cully and Michaels (2000) did not find differences in disturbance between Henslow's Sparrow sites and other sites in Kansas, but did find higher track disturbance on occupied sites during summer, and suggested that flatter terrains were selected both by sparrows and for military exercises. Mazur (1996) in New York also noted that territories were established in flatter parts of fields.

Adult Mortality

Hyde (1939) believed that Harriers (*Circus cyaneus*) were important predators on adults. Graber mentioned predation on sparrows by hawks also (Graber 1968 and references therein). Of 43 sparrows killed at a television tower over 25 years, 39 died during fall migration (Crawford 1981).

Longevity

No data available.

Banding Data

Ten Henslow's Sparrows were recaptured in banding studies. All original bandings and recoveries occurred between March and November and appear to apply to breeding or migration locations. All recaptures took place in the same blocks in which birds were banded (Maryland, Kentucky, Ohio, and Wisconsin). One individual (banded and recovered in Kentucky) was recovered a year later in a different 10-minute block than that in which it was banded in 1999. Six Henslow's Sparrows were recovered 1 year after banding; two sparrows were recovered in the same year and two were recaptured 2 years after banding (data from Bird Banding Laboratory 1933-1999, K. Klimkiewicz, pers. comm.).

Site Fidelity

Five banded adult males returned to a breeding site the following year (Skipper 1998). A breeding population at Fort Drum, New York, showed return rates averaging about 17.0 $\pm$ 1.6 percent (SE; R. Krebs, pers. comm.). Returning birds moved an average of 1.0 km between years (range 0-3.2 km). One return was banded as a juvenile at the site the previous year (R. Krebs, pers. comm.).

Plentovich *et al.* (1998) had no recaptures of 22 wintering sparrows at the same sites the following year but recaptured 13 of 30 sparrows within the same year and indicated that they were site faithful within the same season. Legare *et al.* (2000) found that 8 percent of 90 birds banded in one year returned to the same savannahs the following year; two others were recaptured in the same habitats 3 or more years after banding when the habitat had been burned between the capture and recapture periods. M. Woodrey (pers. comm.) indicated very few recaptures of birds within a wintering season at the Mississippi Sandhill Crane National Wildlife Refuge and suggested that birds move substantially between wintering sites.

Migration

Sparrows appear to leave wintering grounds in mid-March to early April (Graber 1968). Hyde stated that northward movement from the wintering range becomes "noticeable in early March. By the end of the second or third week in April, the species has reached Kansas, northern Illinois, southern Michigan, and New Jersey. The middle of May sees the species at its northern limit" (Hyde 1939). Henslow's Sparrows are regularly observed in Apalachicola National Forest Florida through mid-April, with the latest sighting on 21 April (Pranty and Scheuerell 1997).

Fall migration begins in September, and by late October or November birds have left the breeding grounds (Graber 1968). At the Apalachicola National Forest, Henslow's Sparrows arrive regularly in mid-October (Pranty and Scheuerell 1997). The peak of migration was 1-10 November in 1995 and 11-20 November in 1996, with a few birds still arriving by early December in 1996 (D.B. McNair, pers. comm.).

Food Habits

Hyde (1939) collected data from 17 adults and fledglings and found that animal matter represented 85-100 percent of food from April to September, whereas two stomachs collected in October contained 9-15 percent animal matter. Othopterans made up 36.5 percent of food from August to October; coleopterans 19 percent; hemiptera 12 percent; lepidoptera 3 percent; and hymenoptera 2 percent (Hyde 1939). "Vegetable matter" amounted to 18 percent of the contents examined (Hyde 1939). Most of this consisted of grass and sedge seeds and seeds from the Polygonaceae; for two sparrows 75 percent and 85 percent of their respective October diets were seeds of *Ambrosia elatior*.

Nestling food that Hyde (1939) described was predominantly lepidoptera larvae, spiders, adult sawflies, and orthopterans. Robins (1971b) indicated that 98 percent of food delivered to nestlings was animal; of this, lepidoterans made up 35 percent and orthopterans 18 percent. The remaining 2 percent of non-animal food delivered was grass seed. Kobal *et al.* (1998) observed that 38.5 percent of food delivered to nestlings was lepidopteran, whereas 30.7 percent was orthopteran and 15.4 percent was coleopteran.

Habitat

Breeding Season

Henslow's Sparrow is an obligate grassland species. They historically bred in tallgrass prairie habitat (Herkert 1994c and references therein), but also breed in other grasslands, including hayfields, pastures, and meadows (Graber 1968, Hyde 1939, Smith 1992). Older sources such as Graber (1968), Hyde (1939), and Smith (1968) suggested a preference for "damp" fields, but more recent sources indicate that Henslow's Sparrows breed principally in mesic grasslands (Hands *et al.* 1989, Robins 1971a); Pruitt (1996) believed that moisture is secondary to proper habitat structure. In southwestern Missouri, encounter rates of sparrows tended to be three times higher in mesic and dry prairies compared to wet prairies (Swengel 1996). Mangun and Kolb (2000) described a large population of sparrows in North Carolina as using "wet grass-sedge meadows." Robins (1971a) stated that "very wet or dry areas are avoided." Occupied non-native grasslands may include those dominated by grasses such as meadow fescue (*Festuca pratensis*), Kentucky bluegrass (*Poa pratensis*; Herkert 1994c), and smooth brome (*Bromus inermis*) in Indiana strip mines (S.L. Lima, pers. comm.). Mazur (1996) found that slope was important; territories tended to be established on flatter parts of fields.

Many studies indicated that breeding Henslow's Sparrows may be absent from smaller grasslands, are more likely to be found in larger grasslands, or have increased densities with increasing field size (Bollinger 1995, Herkert 1994c, Kobal *et al.* 1999, McCoy 2000, Mazur 1996, O'Leary and Nyberg 2000, Samson 1980, Walk and Warner 1999). Fragment sizes may be more restrictive in increasingly fragmented landscapes (table 2); in highly fragmented Illinois, sparrows require fragments ≥55 ha, whereas in other places they may

Table 2.—*Minimum area requirement (ha) for Henslow's Sparrow presence in grassland fragments by region*

State/region	Minimum size used (range; *n* sites)	Habitat	Landscape matrix	Author
Central New York	33.2 (8-124; 33)	Pasture	Pasture, forest	Smith 1997
South-central New York	36.0 (1-100; 35)	Pasture	Pasture, forest	Peterson 1983
Southern Illinois	10 (10-320; 32)	CRP fields	Grassland, forest	Harroff 1999
East-central Illinois	75[a] (7-120; 9)	Warm- and cool-season grasslands	Agricultural	Walk and Warner 1999
Northeastern Illinois	15.1 (2.2-16.3; 5)	Cool-season fields	Forest, shrubland	O'Leary and Nyberg 2000
Northeastern and north-central Illinois	55[a] (0.5-650; 24)	Prairie and nonprairie grasslands	Agricultural	Herkert 1994b
Northeastern Illinois	>16 (8.9-97.1; 21)	Fescue, mixed grass, grass/forb fields	Urban	Kobal *et al.* 1999
Southwestern Missouri	>10 (0.5-510; 14)	Prairie	Pasture, hayfield, agricultural, forest	Samson 1980
Southwestern Missouri	31.2 (31.2-1084; 13)	Prairie	Pasture, hayfield, agricultural, forest	Winter and Faaborg 1999

[a] Based on area at which probability of occurrence equals 50 percent of its maximum (Robbins *et al.* 1989).

use smaller fragments 30 ha or smaller, especially if the surrounding region is largely grassland (T. McCoy, pers. comm.; Mazur 1996). In northern Missouri, Henslow's Sparrows were most abundant where there were high amounts of grassland at the landscape level, regardless of the amount of CRP in the landscape (McCoy 2000). In Winter and Faaborg's (1999) study, Henslow's Sparrows in small prairies were in lower densities than in large prairies. Although sparrows were more common on large grasslands in Indiana strip mines, (S.L. Lima, pers. comm.), fragment size did not have a strong effect on Henslow's Sparrow abundance, perhaps because of the large area of contiguous grassland in which sites were located (Bajema and Lima 2001).

Mitchell *et al.* (2000) cited studies from the early part of the 20th century in which Henslow's Sparrows were often found in small fields. They suggested sparrows may appear to require large habitats because preferred sites are occupied first (Mitchell *et al.* 2000 and references therein) and populations are low enough that remaining areas are not used. Mazur's (1996) data support this speculation; she found that occupied fields in New York were 3-20 ha, but larger sites were occupied first. The latter findings are consistent with a population decline, wherein a species occupies only the highest quality sites, "giving a limited impression of the range of habitats it may occupy at higher population densities" (Smith 1997 and references therein).

Bollinger (1995) found Henslow's Sparrows in older hayfields; that is, hayfields that had succeeded the longest (10 to 20 years) after original planting as legume mixtures. Walk and Warner (2000) observed more Henslow's Sparrows in warm-season compared to cool-season grass fields. Bajema *et al.* (2001) found that areas with little grass vegetation other than fescue were unlikely to contain Henslow's Sparrows. Reclaimed strip-mine habitats in Indiana are between 17 and 30 years old and appear to undergo arrested succession, perhaps due to unsuitable soil, tenacity of the Eurasian grasses used in reclamation, and colonization problems due to distance from forest edge (S.L. Lima, unpublished data).

Breeding Microhabitat

Tall and dense cover is a frequently cited requirement (Cully and Michaels 2000, Graber 1968, Hands *et al.* 1989, Hanson 1994, Herkert 1994c, Mazur 1996, Robins 1971a, Skinner *et al.* 1984, Wiens 1969). Clawson (1991) and Mazur (1996) found that sparrows selected plots with higher percent cover than available in random or unoccupied plots. Residual standing dead plant material is also important (Clawson 1991; Herkert 1994b,c; Mazur 1996), although Smith (1997) found that sparrows in New York pastures preferred areas with higher annual growth of new vegetation. Robins (1971a) indicated that territories at his sites were most dense in areas dominated by herbaceous plants, "particularly grasses and sedges" in "frequent dense patches."

High litter density is frequently cited as important for Henslow's Sparrows (Cully and Michaels 2000, Hanson 1994, Mazur 1996, Robins 1971a).

Grasslands used by sparrows generally have fewer trees and shrubs (Cully and Michaels 2000, Mazur 1996, Peterson 1983), but scattered shrubs may be found in occupied areas (Cully and Michaels 2000, Hyde 1939, Peterson 1983). Shrubs may be used as singing perches (Hanson 1994, Robins 1971a), as are forbs projecting above ground cover (Payne *et al.* 1998, Wiens 1969).

Winter Habitats

Winter Henslow's Sparrow habitats differ from breeding habitats by not requiring a litter layer and standing dead vegetation, perhaps because litter is not necessary to hide nests and standing perches are not needed as song posts (D.B. McNair, pers. comm.). Wintering Henslow's Sparrows may use sites that are much smaller than breeding habitats. In southern pine forests, individual sparrows may be found in openings as small as 10 m^2 (M. Woodrey, pers. comm.). In coastal Texas, F. Hannah (pers. comm.) found three sites <1.0 ha that had ≥two sparrows each; one site having three sparrows was only 0.76 ha. In some areas, Henslow's Sparrows used wintering habitats structurally similar to breeding habitats, selecting areas with dense herbaceous vegetation, litter, and standing dead vegetation (F. Hannah, pers. comm.; Plentovich *et al.* 1999).

Although classified as "wetlands," drier pitcher plant (*Sarracenia* spp.) bogs and areas with high densities of the grass *Panicumm vericosum* best explained habitat use in Alabama (Plentovich *et al.* 1999); sparrows were found only around the edges of wet bogs and also avoided dry upland sites, despite the structural similarity of the latter to used areas. W.D. Robinson (pers. comm.) found that Henslow's Sparrows wintering in Florida and Alabama used bogs with no standing water, but nonetheless used areas with wet soil in association with bog plants. Abundance of grass seed was the best predictor of winter habitat use (W.D. Robinson, pers. comm.). In southeastern Georgia, moist areas within maintained powerline rights-of-way create "ideal habitats" (C.R. Chandler, pers. comm.). Sparrows may be found where slight depressions provide wetter habitats and sedges predominate (C.R. Chandler, pers. comm.).

Sparrows occur in high densities in burn-managed "savannahs" (grasslands) in the Apalachicola National Forest, Florida, and the Mississippi Sandhill Crane National Wildlife Refuge (T. Engstrom, D.B. McNair, M. Woodrey, pers. comm.), and Fort Polk, Louisiana (S. Ibargüen, pers. comm.). They are well distributed throughout longleaf pine woodlands as well, but in lower numbers (D.B. McNair, pers. comm.). Spaces between grass clumps may be important because Henslow's Sparrows feed on the ground (M. Woodrey and C. Shackleford, pers. comm.), although sparrows may be found in thick grassy areas as well (F. Hannah, pers. comm.). Along the upper Texas Gulf coast, wintering sparrows were found in a variety of grasslands including degraded small grasslands, openings in pine woods, and disturbed coastal tallgrass prairie remnants; nearly all contained tall dense grasses with standing dead vegetation and litter. However, grasslands that were converted to monocultures of non-native grass did not contain wintering Henslow's Sparrows (F. Hannah, pers. comm.).

Migration Stopover Habitats

Little is known about migration habitat use. Hyde (1939) mentioned that all birds that he considered to be "definitely migrating" were seen along hedgerows or at the edges of shrubby areas. Carleton (1958; cited in Bull 1964) mentioned four sight reports from Prospect Park, Brooklyn, New York. One migrating sparrow was sighted in an open area of LaRue Spring, Illinois (S. Olson, pers. comm.).

Population Trends and Estimates

The North American Breeding Bird Survey is a roadside survey conducted by volunteers, primarily covering the continental United States and southern Canada. It was started in 1966 and covers approximately 4,100 routes (Sauer *et al.* 2000).

Pruitt (1996) remarked that "large-scale changes in habitat availability for Henslow's Sparrow occurred prior to any range-wide monitoring programs," so that by the time the survey was initiated Henslow's Sparrow populations had already declined from their historic highs throughout most of their range. Recent analysis of BBS data (1966-1999) indicates a survey-wide average annual decline of 7.7 percent, with declines of 8.3 percent and 7.8 percent for Canada and the United States, respectively (2 and 147 routes, respectively; Sauer *et al.* 2000). However, all long-term trends for Henslow's Sparrow populations are based on small numbers of routes having sparrows, and very low relative abundances of birds per route, so they may be imprecise (fig. 1; Sauer *et al.* 2000).

Henslow's Sparrows occupy established grasslands and frequently move their breeding territories in response to changes in the availability of suitable habitats. Because Henslow's Sparrows are sporadically present on BBS routes, these counts are associated with relatively high variances that contribute to the imprecision of the trend estimates and uncertainty over the actual rate of population change. In addition, BBS routes may not include habitats such as reclaimed strip mines and military bases, some of which have recently been found with large populations of Henslow's Sparrows, so that some local increases are not evident in the survey data. Over the long term, however, Henslow's Sparrows have disappeared from many more sites than where they have appeared, which is consistent with the population declines reported by the BBS (B. Peterjohn, pers. comm.; Peterjohn and Sauer 1999).

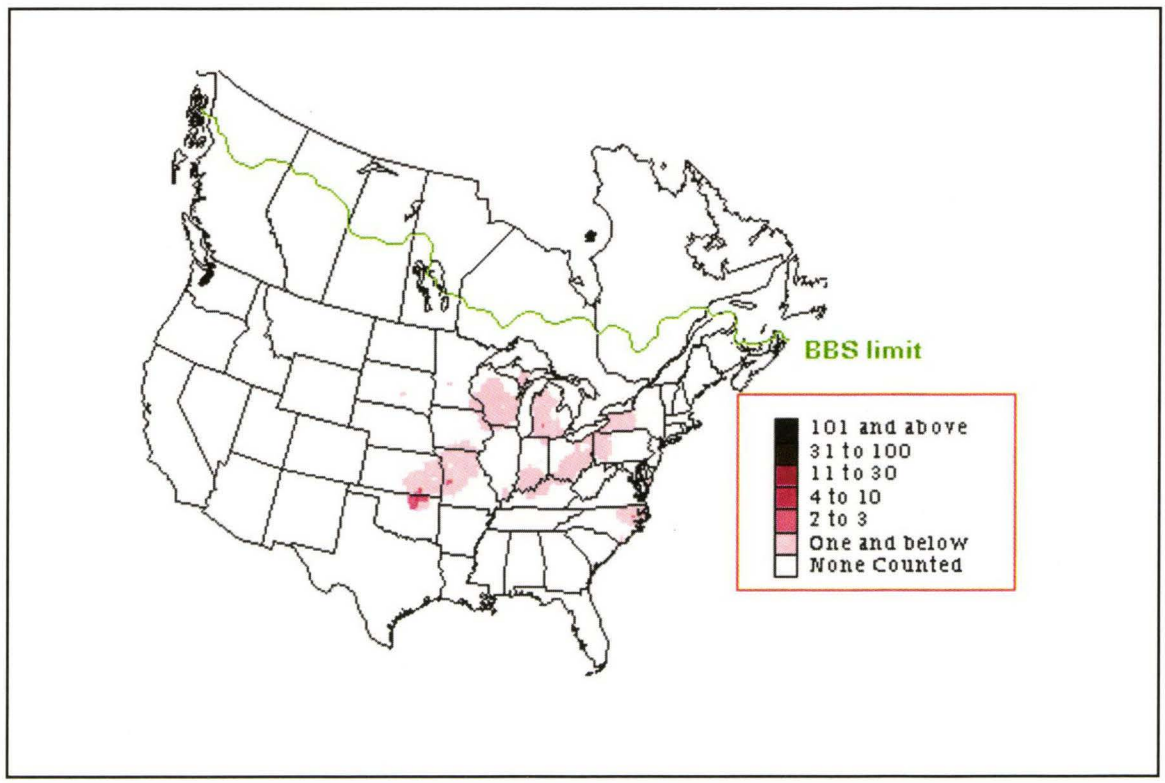


Figure 1.—Map of Henslow's Sparrow relative abundance as indicated by surveys on Breeding Bird Survey (BBS) routes.

Breeding Bird Census

The former U.S. Bureau of Biological Survey initiated the Breeding Bird Census (BBC) in 1914; the BBC has also been administered by the National Audubon Society, and more recently, the Cornell Laboratory of Ornithology until 1996. The Breeding Bird Census program uses study plots within a single habitat type. Standard vegetation and breeding criteria are used to establish breeding bird and vegetation communities.

From 1937 to 1990, there were at least 30 Henslow's Sparrow records out of about 3,660 censuses (J. Lowe, pers. comm.). The majority of eastern Breeding Bird Censuses occur in forested habitats not having Henslow's Sparrows; most grassland censuses are in the Great Plains west of the Henslow's Sparrow's breeding range (J. Lowe, pers. comm.).

Christmas Bird Count

The Christmas Bird Count (CBC) sponsored by the National Audubon Society began in 1900 (Butcher 1990). The goal of the count is to count birds within a 15-mile-diameter circle within 2 weeks of Christmas. Although the count is considered the oldest and largest wildlife survey in the world (Butcher 1990), inherent biases in the method (Arbib 1981) make the count weak for Henslow's Sparrows. Not all habitats may be adequately covered or properly reported by CBCs (Arbib 1981), and areas that are preferred by bird watchers may be preferentially covered (Bock and Root 1981). Thus, CBCs may not do a good job of measuring abundances of birds with extremely localized distributions such as Henslow's Sparrow (L. Pruitt, pers. comm.).

Breeding Bird Atlases

Breeding Bird Atlas projects usually use a sampling process established by the North American Ornithological Atlas Committee based on the 7.5-minute topographic map system. Maps are typically divided into six blocks comprising 25 km^2 each, and usually one of the six blocks is randomly selected for surveying. The North American Ornithological Atlas Committee's Standardized Breeding Code Criteria are used to place birds in one of three categories: (1) possible breeders, (2) probable breeders, and (3) confirmed breeders within the block. In the following sections, atlas data are presented in the State summaries and in figure 2.

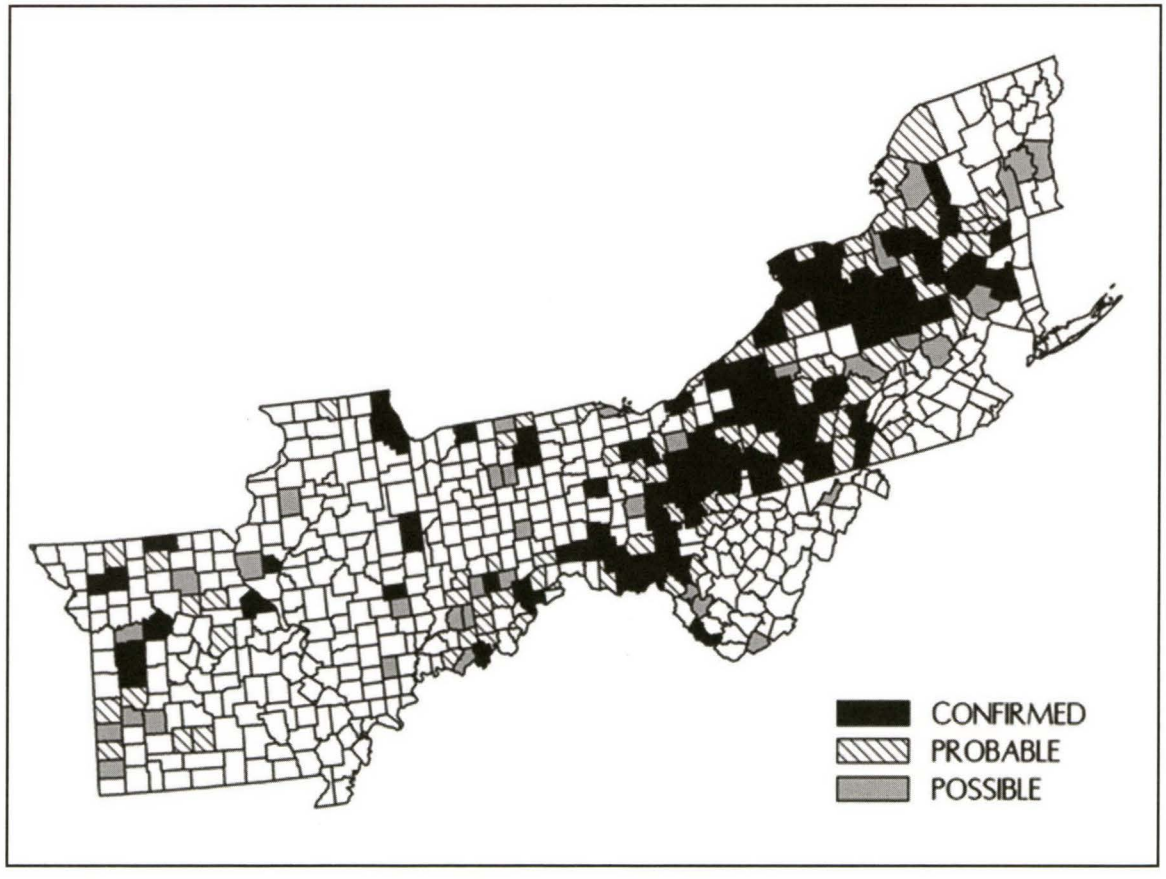


Figure 2.—Map of Henslow's Sparrow breeding abundances by county from breeding bird atlases for focal assessment States (Illinois, Indiana, Missouri, Ohio, New York, Vermont) and Pennsylvania and West Virginia. Counties are shaded according to the highest ranking (confirmed, probable, possible) for any atlas block within the county. Confirmed: individuals carrying nest material, performing distraction display, nest found, or recently fledged young observed; Probable: territorial behavior, courtship display, or agitated behavior; Possible: singing male present or individual seen but not necessarily in suitable habitat. Map by William Dijak and Kevin Heun.

State Summaries

The following summaries are for the States whose lands are included in the Shawnee, Wayne, Hoosier, Mark Twain, and Green Mountain/Finger Lakes National Forests.

Illinois

Summary

Breeds statewide, fairly common in the southern part of the State, decreasing in abundance northward (J. Herkert, pers. comm.). Several large new populations have recently been discovered in the southern part of the State (Herkert 1997b), and recent surveys suggest a possible increase.

History

Before 1900, Henslow's Sparrow was considered abundant in Illinois (Herkert 1994c and references therein), but surveys by Graber and Graber between 1957 and 1979 suggested a decline of as much as 94 percent, which they attributed to loss of grassland habitat (Herkert 1994c). The Illinois Spring Bird Count, a statewide annual survey, recorded Henslow's Sparrows in 27 of the State's 102 counties from 1975 to 1995 and indicated a cumulative 78-percent decline over the period (Herkert 1997a). However, sparrows have become more common recently and have now been detected in 43 counties (1975 and 2000; J. Herkert, pers. comm.). Detections in the 2000 Spring Bird Count were 142 individuals vs. mean count of 15 birds/year for the previous years (1975 and 1999; J. Herkert, pers. comm.).

Henslow's Sparrows were recorded in 13 (15 percent) of 86 tracts in 24 grassland fragments censused between 1987 and 1990 in northeastern and north-central Illinois (Herkert 1994c). Recently some comparatively large populations were discovered (Herkert 1997b) and Henslow's Sparrows may be increasing in CRP lands in the southern part of the State (N. Harroff, pers. comm.; U.S. Fish and Wildlife Service 1998).

BBS

No reliable trend estimate is available from the BBS (Sauer *et al.* 2000).

BBA

Breeding Henslow's Sparrows were recorded as confirmed, probable, or possible on 18 priority and other blocks (1,025 priority blocks total) in the State as of 1991, but have been found in many additional areas since the atlas was completed in 1991 (V. Kleen, pers. comm.).

Research/Monitoring

Herkert and Glass (1999) studied Henslow's Sparrow response to fire management. Herkert studied Henslow's Sparrow habitat selection (Herkert 1994c), use of CRP lands (Herkert 1997a), and fragmentation and management (Herkert 1994a,b, unpublished data). O'Leary and Nyberg (2000) studied fragmentation of grasslands by fencerows. Kobal *et al.* (1998, 1999) and Payne *et al.* (1998) recently studied nestling diet, fragmentation, and perch use of grassland birds in Illinois, including Henslow's Sparrow. Harroff (1999) is studying suitability of CRP land for numerous small populations of Henslow's Sparrows in southern Illinois.

Major Populations

Until the early 1990s only one large population (≥15 pairs) was known from Illinois (Goose Lake Prairie; Herkert 1994c, 1997b). Presently many such populations are known, including populations at the Jasper and Marion County Prairie-Chicken Sanctuaries (Prairie Ridge State Natural Area), Des Plaines Conservation Area, Iroquois County Conservation Area, and Midewin National Tallgrass Prairie. Many additional large populations have been found in the southern part of the State, including a large population containing 28 territorial males at the Pennant Bar Ranch (Shawnee National Forest) and 20 territorial males on another tract (Herkert 1997b). Harroff (1999) surveyed 32 sites in 11 counties in southern Illinois, many within the Shawnee National Forest region. Populations varied from 1 to 35 birds/field in sites from 10 to 320 ha. She counted 218 singing males in 1998 and believes that the population there is continuing to expand.

State Status

Endangered.

Natural Heritage Rank

S2.

Indiana

Summary

Breeds statewide (R.P. Hellmich, pers. comm.). Scattered in northern Indiana, but more abundant in the southern half. Several large and relatively new populations are in southern Indiana.

History

Historic records are from northern Indiana; Henslow's Sparrow has likely declined there due to loss of grassland habitat (Pruitt 1996).

BBA

Breeding Henslow's Sparrows were recorded as confirmed, probable, or possible in 5.9 percent of 647 blocks in the State and sighted in another 22 non-priority blocks (1985-1990). Most birds were found in the southern half of the State, and none were indicated in the reclaimed coal mine region, which contains a large population (see below; J. Castrale, pers. comm.; Castrale *et al.* 1998).

BBS

Henslow's Sparrows were represented on nine routes in Indiana from 1966 to 1999; trend estimate was 3.7 (P = 0.78); relative abundance = 0.11. Data are inadequate to estimate credible State trends (Sauer *et al.* 2000).

Research/Monitoring

Bajema and Lima (2001) and Bajema *et al.* (2001) recently studied use of reclaimed coal mines by Henslow's Sparrows in southwestern Indiana. Seventy-seven active nests have been found in a population monitored on the Big Oaks National Wildlife Refuge (J. Robb, pers. comm.).

Major Populations

An estimated several thousand Henslow's Sparrows breed in 19 reclaimed coal mine grasslands in southwestern Indiana (Bajema and Lima 2001). An estimated 800 to 1,000 pairs are in the Big Oaks National Wildlife Refuge, formerly the Jefferson Proving Grounds (J. Robb, pers. comm.). Grasslands on the southern cantonment area of the closed base have been leased and converted to agriculture, reducing the several hundred pairs formerly nesting in this section to a few (J. Robb, pers. comm.). In Johnson County, Koford (1999) detected 75 and 33 singing males at the Atterbury State Fish and Wildlife Area and Camp Atterbury, respectively.

State Status

Endangered.

Natural Heritage Rank

S2.

Missouri

Summary

Henslow's Sparrows currently breed in Missouri prairie remnants, hayfields, and pastures with residual dead vegetation (Jacobs and Wilson 1997). Sparrows are numerous in prairies in the southwestern part of the State.

History

Formerly much more common throughout the prairie region in northern, central, and southwestern Missouri (Robbins and Easterla 1992).

BBA

Henslow's Sparrows were reported as confirmed, probable, or possible breeders in 32 (2.7 percent) of 1,207 blocks (1986 to 1992; Jacobs and Wilson 1997).

BBS

Henslow's Sparrows were represented on eight routes in Missouri from 1966 to 1999; trend estimate was 7.7 (P = 0.38); relative abundance = 0.35. Data are inadequate to estimate credible State trends (Sauer *et al.* 2000).

Research/Monitoring

M. Winter recently studied Henslow's Sparrow nesting biology and effects of fragmentation in prairies in southwest Missouri (Winter 1999, Winter and Faaborg 1999). Swengel studied management responses of sparrows in the same region (Swengel 1996). McCoy studied use of Conservation Reserve Program (CRP) lands in northern Missouri (McCoy 2000, McCoy *et al.* 1999).

Major Populations

Swengel counted 1,193 Henslow's Sparrows on surveys in 42 prairies in southwestern Missouri from 1992 to 1995 (Swengel 1996). He estimated 5,000-6,000 pairs of sparrows in the region (Pruitt 1996) but suggests that numbers may have declined to two-thirds of that number since (S.R. Swengel, pers. comm.). Skinner *et al.* (1984) counted 1,428 Henslow's Sparrows from 29 plots in the same region from 1976 to 1978. Harrison County in north Missouri may contain a large population centered on the Dunn Ranch (B. Jacobs, pers. comm.; Wilson 1998, 1999). Grasslands near Moberly may contain populations (Wilson 1998). McCoy (2000) recently documented a number of small Henslow's Sparrow populations in north-central Missouri as part of a study on songbird use of CRP lands. Average abundances were 0.3 + 0.7 (SD)/k transect from 1993 to1995 and 0.6 + 0.7 (SD)/k transect for additional sites from 1997 to 1999. Henslow's Sparrows were present in 33 percent and 44 percent of these sites from 1993 to 1995 and 1997 to 1999, respectively (McCoy 2000).

State Status

Species of concern.

Natural Heritage Rank

S2.

New York

Summary

Henslow's Sparrows breed in New York in abandoned hilltop farms and grassy ridgetops (Andrle and Carroll 1988), fallow fields, and pastures.

History

Rare and local in the early 1900s (Andrle and Carroll 1988 and references therein). Increases were documented from the 1920s to 1940s (Andrle and Carroll 1988 and references therein), after which the sparrow was reported less frequently. In 1950, 21 nesting pairs were reported "from Kensico Reservoir to the Putnam County line" (Bull 1964).

BBA

Henslow's Sparrows were reported as confirmed, probable, or possible breeders in 348 (7 percent) of 5,323 blocks (1980 to 1985; Andrle and Carroll 1988).

BBS

Henslow's Sparrows were represented on 28 routes in New York from 1966 to 1999. Although populations show a statistically significant trend estimate of -14.2 ($P < 0.005$; relative abundance = 0.17), data are inadequate to estimate credible State trends (Sauer *et al.* 2000).

Research/Monitoring

A study of grassland birds including Henslow's Sparrow was recently completed for Fort Drum (S. Joule, pers. comm.). A study specifically on Henslow's Sparrows is also being conducted at Fort Drum (R. Krebs, pers. comm.). The Massachusetts Audubon Society conducts censuses of Henslow's Sparrows in New York State (A. Jones and G. Shriver, pers. comm.), and the Finger Lakes National Forest conducts surveys on pastures in the Finger Lakes region (C. Grove and C.R. Smith, pers. comm.). Mazur (1996) studied habitat use at Saratoga National Historical Park.

Major Populations

A population conservatively estimated at 30-40 pairs breeds on 20,000 acres of contiguous grassland at Fort Drum (S. Joule and R. Krebs, pers. comm.). A population of 30 singing males in the Finger Lakes region (Schuyler County) was censused in 1997 (The Massachusetts Audubon Society, unpublished data). None of the birds in the Finger Lakes region were detected on active pastures in 1999, apparently due to extreme drought conditions of 1998 and 1999 (C.R. Smith,

pers. comm.). Counts by The Massachusetts Audubon Society throughout New York indicated means of 3.9 ± 5.0 (SD) singing males at 46 sites in 1997 and 1.9 ± 1.9 (SD) singing males at 18 different sites in 1999 (The Massachusetts Audubon Society, unpublished data).

State Status

Threatened.

Natural Heritage Rank

S3B.

Ohio

Summary

Henslow's Sparrows breed in Ohio in abandoned strip mines, most in the southeastern part of the State.

History

Henslow's Sparrows were found in western Ohio in the early part of the 20th century. Now they are largely gone from this region and are concentrated in reclaimed strip mines in southeastern Ohio (S. Hull and B. Peterjohn, pers. comm.). Several populations were also proximate to reservoirs (Pruitt 1996 and references therein). Surveys of the Paint Creek reservoir indicated birds were present between 1977 and 1981, but the population was lower by 1986 due to secondary succession producing unsuitable habitat (B. Peterjohn, pers. comm.). Sparrows now seem to have disappeared completely from these reservoir habitats (Koford 1999).

BBA

Henslow's Sparrows were reported as confirmed, probable, or possible breeders in 144 (18.9 percent) of 764 blocks (1982 to 1987). Distribution was centered along the boundary between glaciated and unglaciated Ohio (Peterjohn and Rice 1991).

BBS

Henslow's Sparrows were represented on 20 routes in Ohio from 1966 to 1999; trend estimate was −1.1 (P = 0.80); relative abundance = 0.20. Data are inadequate to estimate credible State trends (Sauer *et al.* 2000).

Research/Monitoring

A collaborative study between the Ohio Division of Wildlife and Ohio State University researchers is determining genetic differentiation among breeding Ohio Henslow's Sparrow populations and is examining genetic links between wintering and breeding populations (S. Ibargüen, pers. comm.).

Major Populations

Large populations (100-200 pairs) breed on reclaimed strip-mine lands owned by the Ohio Division of Wildlife (Crown Valley, Egypt Valley, Tri-Valley and Woodbury Wildlife Areas; S. Hull and S. Ibargüen, pers. comm.). Koford (1999) counted 444 singing males throughout Ohio in a 1997 survey, mostly in regions of the State with reclaimed strip mines.

State Status

Species of special interest.

Natural Heritage Rank

S4.

Vermont

Summary

Henslow's Sparrows have not been detected in Vermont since 1986 (Ellison 1992). A few sightings occurred in the past 5 years, but all are unconfirmed (J. Peterson, pers. comm.).

History

Henslow's Sparrows were infrequently sighted in Vermont throughout most of the 20th century but were reported across the State in the 1930s and between 1948 and 1954 (Ellison 1992 and references therein). A 1992 survey of 28 towns in the Champlain Lowlands and adjacent areas reported no Henslow's Sparrows (Ellison 1992). Several sources (P. Vickery, pers. comm., Kibbe and Laughlin 1985) believe that suitable Henslow's Sparrow habitat still exists in Vermont. Vermont may be outside of the species' present breeding range (P. Vickery, pers. comm.;

Ellison 1992); in addition, upland grasslands are becoming rare in Vermont, and farming in general is becoming more intensive, with little land under CRP (S. Parren and J. Peterson, pers. comm.).

BBA

A single singing male was reported on 1 out of 179 priority blocks; an additional singing male was noted elsewhere in the State in 1981 (1977-1981; Kibbe and Laughlin 1981).

BBS

No reliable trend estimate is available from the BBS (Sauer *et al.* 2000).

Major Populations

Few or no populations of Henslow's Sparrows exist presently in the State.

State Status

Endangered.

Natural Heritage Rank

S1B.

Threats

Present or Threatened Destruction, Modification, or Curtailment of Species' Habitat or Range

Changes in land use, particularly loss of grassland, are the major threats to Henslow's Sparrows. Native grasslands are now considered by many to be North America's most endangered ecosystem (Mitchell *et al.* 2000, Vickery *et al.* 1999 and references therein). Although the major loss of grassland occurred during the middle of the 20th century, loss continues to occur as former pastures are converted to row crops such as corn and soybeans (O'Leary and Nyberg 2000, Robinson 1997). Rapidly growing varieties of hay allow farmers to harvest hay earlier than before, which results in destruction of nests of grassland birds (Robinson 1997). In addition, "passive" loss of grassland due to natural succession, fire suppression, and ensuing woody encroachment makes habitats unsuitable.

Henslow's Sparrows are especially vulnerable to habitat fragmentation. Although small grasslands of potentially suitable habitat exist, numerous studies indicate that Henslow's Sparrows require large habitats, especially on the breeding range (Bollinger 1995, Herkert 1994c, Kobal *et al.* 1999, Mazur 1996, O'Leary and Nyberg 2000, Walk and Warner 1999).

Threats to Wintering Grounds

There are fewer data on use of habitats on the wintering grounds, but loss of suitable wintering habitat is a problem also, particularly where grasslands are developed or converted to intensive grazing. The longleaf pine ecosystem is greatly reduced from its former extent (D.B. McNair, pers. comm.) and requires burning to remain suitable habitat for wintering (Pruitt 1996).

In a study comparing museum specimens from the late 19th and early 20th century to present day abundances, McNair and Post (2000) found that Henslow's Sparrow were much more numerous in South Carolina 70-115 years ago. The decline is consistent with loss of grasslands in the Southeast since the 1950s and conversion to row crops (McNair and Post 2000).

Present and Historical Breeding Habitat Loss

Tallgrass prairie was formerly the dominant habitat throughout the Midwest, occupying some 31 million hectares in Illinois, Indiana, Iowa, Michigan, Minnesota, and Wisconsin prior to European settlement (Herkert 1994a and references therein). Grassland loss has exceeded 80 percent in many areas, and only 0.1 percent of native prairie remains in some areas (Vickery *et al.* 1999 and references therein). Before European settlement, native grasslands were also more extensive in eastern North America, where cultivation by Native Americans and natural disturbances such as fire maintained large grassland habitats (Askins 2000). More recently, much farmland in the Northeast has been abandoned and returned to forest (Askins 2000).

In Canada, 25 percent of native grasslands remain (Vickery *et al.* 1999 and references therein). Like those in the United States, grasslands in Canada have also become more fragmented (Houston and Schmutz 1999). The Canadian government's historic encouragement of grain rather than cattle production has also decreased pasture and hayfields in favor of cropland, although this situation has changed recently (Houston and Schmutz 1999).

In a prioritization analysis of grassland birds in the U.S., Wells and Rosenberg (1999) estimated that 21.3 percent of Henslow's Sparrow's breeding range was in the Northeastern U.S (USFWS region-5). They ranked the sparrow first in conservation priority for the northeastern region.

Present and Potential Non-breeding Habitat Loss

Winter Habitat

Large public reserves such as the Apalachicola National Forest, the Conecuh National Forest, and the Mississippi Sandhill Crane National Wildlife Refuge

appear to provide substantial habitat. In Texas, development and fire suppression have converted or altered many wintering sites (F. Hannah, pers. comm.). Although sparrows will use fields containing non-native grasses, large-scale conversion of grasslands into "improved pastures," where native grasses are wholly replaced with introduced fescue and coastal Bermuda grass (*Cynodon dactylon*), seems to be detrimental to winter habitat use (C. Shackelford, pers. comm.). Bahia grass (*Paspalum notatum*) and Chinese tallow (*Sapium sebiferum*) have also invaded and degraded potential sites (F. Hannah and C. Shackelford, pers. comm.).

Migration Habitat

Little is known about migratory stopover habitat; Hyde (1939) mentioned that all birds that he considered to be "definitely migrating" were seen along hedgerows or at the edges of shrubby areas. Reinking *et al.* (in press) observed a tendency for sparrows to move into "areas in late July or August which were not suitable for nesting earlier in the season because of recent fire or grazing, and which did not contain Henslow's Sparrows in May or June," suggesting that requirements for post-breeding habitat are not as strict as those for nesting habitat; however, similarities between post-breeding and migration habitat are not known.

Overuse for Commercial, Recreational, Scientific, or Educational Purposes

Henslow's Sparrows are not of commercial value, and their use for recreational, scientific, and educational purposes does not pose a threat to populations at this time.

Disease or Predation

Disease has not been investigated in this species. Hyde (1939) reported red mites (*Trombicula bisignata*) on the skin of the ear, anus, and other parts of summer sparrow specimens. Unidentified Mallophaga were found on birds taken by Hyde in Lawrence County, New York (Hyde 1939). Unidentified ticks were collected from banded birds in New York State (R. Krebs, pers. comm.).

Nest predation is a potential problem for this species, but data on nesting success have been difficult to obtain until recently; even data from several recent nesting studies have not been fully analyzed at the time of this writing. Winter's (1999) nesting study suggested that southwestern Missouri is a productive breeding area for Henslow's Sparrows; Winter and Faaborg (1999) found that nesting success was higher for Henslow's Sparrows than for three other species at the same sites. Several other studies indicate relatively high rates of nesting success (table 1). However, small samples of nests over very few studies make it hard to generally assess the impact of nest predation on Henslow's Sparrow populations.

Brood parasitism by the Brown-headed Cowbird does not appear to be an important source of mortality, as few parasitized nests have been documented. Grassland species generally suffer less from cowbird parasitism than forest birds or species of the forest edge (Robinson and Herkert 1997). Henslow's Sparrow's preference for larger grassland tracts may also contribute to reduced parasitism levels, because grasslands of larger size appear to be less susceptible to parasitism. This may be because of greater distances from forest edge (Johnson and Temple 1990) or reduced proximity of cowbird perches, which have been shown to influence parasitism for some species (Clotfelter 1998, Hauber and Russo 2000). Henslow's Sparrows also are able to fledge their own young when parasitized (Reinking *et al.*, in press; Winter 1999), probably because they have short incubation periods. Many hosts that hatch after cowbirds perish in competition with larger cowbird chicks (Robinson *et al.* 1995), whereas even small hosts that hatch on the same day as cowbirds may successfully fledge along with cowbird nestmates.

Inadequacy of Existing Regulatory Mechanisms

The U.S. Fish and Wildlife Service was recently petitioned to list the species under the Endangered Species Act; the Service did not find that listing was warranted (U.S. Fish and Wildlife Service 1998) and the species remains a "Migratory nongame bird of management concern" (U.S. Fish and Wildlife Service 1995, 1997).

Table 3.—*Legal status of Henslow's Sparrow in States and provinces*[a] *within its range*

State/province	Legal status[b]
Alabama	
Arkansas	
Connecticut	SC
Delaware	E
District of Columbia	
Georgia	
Iowa	T
Illinois	E
Indiana	E
Kansas	C
Kentucky	S
Louisiana	
Maryland	T
Massachusetts	E
Michigan	T
Minnesota	E
Missouri	SC
Mississippi	SC
Nebraska	
New Hampshire	SC
New Jersey	E
New York	T
North Carolina	
Ohio	S
Oklahoma	
Pennsylvania	
Rhode Island	SH
South Dakota	
Tennessee	PD
Texas	
Vermont	E
Virginia	T
West Virginia	
Wisconsin	T
Ontario	"Imperilled"
Quebec	"Accidental"

[a] From Austen *et al.* 1997.

[b] E—endangered, T—threatened, SC—species of concern, PD—potentially deemed in need of management, S—sensitive, C—of conservation concern, SH—state historical. Reflects current status as of August 2000 (not all States that have Henslow's Sparrows have a listing; some States may use different letter designations but categories are equivalent; B. Robertson, pers. comm.). Provided courtesy of Bruce Robertson and Mike Carter through Cornell laboratory of Ornithology and Colorado Bird Observatory.

The Migratory Bird Treaty Act of 1918 provides protection of Henslow's Sparrows through direct take. Section 404 of the Clean Water Act and the National Environmental Policy Act of 1969 (NEPA) may provide protection for some habitats used by sparrows (Pruitt 1996). Wetlands are regulated by the U.S. Army Corps of Engineers under section 404 of the Clean Water Act, which prohibits discharge of dredged or fill materials into waters of the United States. Henslow's Sparrows use some habitats proximate to wetlands or in association with wetland plant species (Plentovich *et al.* 1999; Pruitt 1996; W.D. Robinson and D.B. McNair, pers. comm.) and may receive limited protection.

Henslow's Sparrow receives State protection through existing State wildlife codes. Additionally it is listed as endangered, threatened, species of concern or conservation concern, sensitive, or potentially deemed in need of management in 22 States (table 3; B. Robertson, pers. comm.).

The Conservation Reserve Program (CRP) of the United States Department of Agriculture was initiated to reduce crop surpluses, protect soil from erosion, and in part to conserve potential wildlife habitat (Herkert 1997a, Johnson and Schwartz 1995). Landowners receive annual payments for enrolling in the program during 10 years of the contract. Approximately 31.4 million acres are currently enrolled under CRP (Farm Service Agency 2000). Several studies have suggested that CRP lands may function as reserves of breeding habitat for grassland songbirds (Herkert 1997a, Johnson and Igl 1995, Johnson and Schwartz 1995, McCoy *et al.* 1999). Conservation Reserve Program land may provide potential habitat for Henslow's Sparrows. Herkert (1997a) suggested that CRP lands may be particularly attractive to Henslow's Sparrows because fields are usually not disturbed by mowing, grazing, or burning.

Herkert (1997a) analyzed Henslow's Sparrow county population trends and CRP enrollment in Illinois and found that percent population change/year was greater for those counties with high enrollment in CRP. However, he emphasized that benefits from CRP enrollment have not been sufficient to alter long-term population declines in Henslow's Sparrow in Illinois (Herkert 1997a).

The Conservation Reserve Program has potential limitations in utility of long-term habitat; in Illinois, it affects less than 2.5 percent of the State land area and has been costly to maintain (Herkert 1997a and references therein). Additionally, the fate of the lands after CRP expires is uncertain, although CRP was extended under the 1996 Farm Bill. In addition, lands under prolonged CRP tenure may succeed to shrubland habitat that becomes unsuitable for Henslow's Sparrows.

Henslow's Sparrows spend their entire life cycle within the continental United States and are not subject to regulations from other countries. Although size requirements for wintering habitat tracts appear to be smaller than for breeding habitat, further research is needed on the range of habitats and sizes for optimal wintering habitat (see below). Certain wintering habitats, such as pitcher plant bogs, may not receive sufficient protection (Plentovich *et al.* 1999).

The prospect of fire suppression, particularly in light of recent catastrophic prescribed burns on public lands, would limit the options available to managers in both breeding and wintering (Plentovich *et al.* 1999, Pruitt 1996) habitats.

Habitat Fragmentation

Fragmentation is an important consideration for presence of breeding Henslow's Sparrows (table 2). These sparrows are often more likely to be absent from or in lower numbers in small tracts than other grassland songbird species breeding in the same locations. For example, in Illinois, Herkert (1994b) and Walk and Warner (1999) found that Henslow's Sparrows required patches no smaller than 55 ha and 75 ha, respectively.

Although their results are based on a small sample from one location, O'Leary and Nyberg (2000) found that Henslow's Sparrows avoided small fields (2.2-4.5 ha) that were separated from larger sites (c. 15 ha) by only a tree line. In New York, Mazur (1996) found that Henslow's Sparrows occupied fields as small as 3 ha, but that these were adjacent to larger fields. Winter and Faaborg (1999) found that while fragment size affected density, birds were present in prairies as small as 31.2 ha. Although there are exceptions, the overall picture is that large grassland sites in a grassland-dominated landscape are desirable for attracting breeding Henslow's Sparrows.

Summary of Land Ownership and Existing Habitat Protection for Populations

Illinois

Forest Service

Three fields surveyed by Natasha Harroff (Harroff 1999) were on Shawnee National Forest lands. One of these, the 800-acre Pennant Bar Ranch (Herkert 1997b) was burned in the past; however, resistance to burning by some sectors of the public may restrict future management options (M.D. Spanel, pers. comm.). Woody succession by cedar and exotics such as autumn olive (*Elaeagnus umbellata*) would make the area unsuitable for sparrows; hand-removal of cedars (*Juniperus virginiana*) is planned for the future (M.D. Spanel, pers. comm.). Henslow's Sparrow is a confirmed breeder at Midewin National Tallgrass Prairie near Chicago; in 1999 at least 14 pairs were counted, which is likely an underestimate of the true population (C.J. Whelan, pers. comm.). Management plans include provisions for shortgrass and tallgrass bird species. Temporary removal of some areas from grazing has allowed some woody invasion; inclusion of recreational activities, future development of industrial parks, and a landfill on former arsenal land adjacent to the reserve potentially affect breeding birds, but those aspects will have to be evaluated as they occur (C.J. Whelan, pers. comm.).

Other Public

Populations are on public lands at the Goose Lake Prairie State Natural Area, the Jasper and Marion County Prairie-Chicken Sanctuaries (Prairie Ridge State Natural Area), the Des Plaines Conservation Area, and the Iroquois County Conservation Area (J. Herkert, pers. comm.; Herkert 1997b).

Private

A comparatively large population breeds on a private 300-acre "idle field" (Herkert 1997b). Several large populations are known from private lands enrolled in CRP in southern Illinois (J. Herkert, pers. comm.; Herkert 1997a, b).

Indiana

Forest Service

Known occurrences of Henslow's Sparrow on Hoosier National Forest land are on a 15- to 20-acre tract in Indiana proximate to private lands that may contain sparrows (S. Olson, pers. comm.), and a 103-acre opening (K. Reynolds, pers. comm.). At least two sites (30 acres and 188 acres respectively) are in proximity to known sparrow locations and may provide future habitat. The current Hoosier management plan does not provide for grazing, but prescribed fire is used on timbered and open land sites (S. Olson, pers. comm.).

Other Public

The Big Oaks National Wildlife Refuge is managed by the Fish and Wildlife Service on U.S. Army land (J. Robb, pers. comm.). The Indiana Department of Natural Resources owns or manages many reclaimed strip mines in southwestern Indiana (S.L. Lima, pers. comm.).

Public

Most reclaimed strip mines in southwestern Indiana are still owned by mining companies (S.L. Lima, pers. comm.).

Missouri

Forest Service

Approximately 40 warm-season pastures ranging from 11 to 88 acres provide possible Henslow's Sparrow habitat in the Cedar Creek Unit of the Mark Twain National Forest in central Missouri. About another 60 fescue fields ranging from 18 to 90 acres may provide habitat also. Current management enhances warm-season grass species by heavy grazing for several weeks in early spring and in the fall to reduce the vigor of competing fescue. Cattle are typically rotated to nearby fescue fields during the midsummer warm-season growing period (S.

Herndon, pers. comm.). No formal surveys have been conducted, but breeding Henslow's Sparrows are regularly present on warm-season pastures as small as 30 acres (D. Burhans, pers. obs.).

Other Public and Private

More than 50 public prairie reserves are owned by the Missouri Department of Conservation, The Missouri Prairie Foundation, The Nature Conservancy, and the Missouri Department of Natural Resources in southwestern Missouri (Swengel 1996, Winter 1999). Dunn Ranch (The Nature Conservancy) and the nearby Pawnee Prairie Conservation Area (Missouri Department of Conservation) in northern Missouri may contain large populations (B. Jacobs, pers. comm.). CRP lands in the north-central part of the State contain a number of small populations (McCoy 2000).

New York

Forest Service

Populations in the Finger Lakes region use 33 pastures in the Finger Lakes National Forest (Smith 1997). Suitability appears to depend upon pasture size, distance to horizon, and grazing effects (D.C. Grove, pers. comm.). More than 340 acres of newly acquired grasslands are to be left ungrazed and managed for wildlife habitat (USDA Forest Service 1999). As with other locations, succession remains a threat to Henslow's Sparrow habitat and is difficult to reverse when shrubs become established (D.C. Grove, pers. comm.).

Other Public

The largest population in New York is found on Fort Drum, U.S. Army (S. Joule, pers. comm.).

Private

Eighty-nine percent (54 of 61) of sites surveyed throughout the State by the Massachusetts Audubon Society were on private lands (The Massachusetts Audubon Society, unpublished data). Bollinger (1995) found Henslow's Sparrows on privately owned hayfields in Madison and Tompkins Counties.

Ohio

Forest Service

Several reclaimed strip-mine areas in the Wayne National Forest contain Henslow's Sparrows but have not been formally surveyed. Encroachment by black locust (*Robinia psuedoacacia*) and pine (*Pinus* species) may degrade reclaimed strip-mine habitat potential for Henslow's Sparrows (L. Andrews, pers. comm.). The current management plan for the Wayne National Forest does not provide for maintenance of grassland habitats.

Other Public

Reclaimed strip mines owned by the Ohio Division of Wildlife hold the largest populations. Small public prairies in southern Ohio may have small populations (S. Ibargüen, pers. comm.).

Private

Henslow's Sparrows were among the most abundant bird species at The Wilds, a large (3,700 ha) area of reclaimed strip mines in east-central Ohio that has been developed into a nonprofit outdoor wildlife conservation center and park (D.J. Ingold, pers. comm.).

Vermont

Forest Service and Other Public

Appropriate areas may exist on some public lands, including grasslands in the Champlain and Connecticut Valleys managed by the Vermont Fish and Wildlife Department, and airports (P. Vickery, C. Rimmer, and S. Parren, pers. comm.).

Private

Champlain Valley grasslands are mostly in private ownership (S. Parren, pers. comm.).

Management Acivities

General Management Approach

Management for Henslow's Sparrows on public land is often a byproduct of managing for other species. For example, large numbers of Henslow's Sparrows winter in the Mississippi Sandhill Crane National Wildlife Refuge, whose mandate is to manage the endangered Mississippi Sandhill Crane and its habitat. In Missouri and Illinois, some habitats that contain Henslow's Sparrows are managed for Greater Prairie Chicken (*Tympanchus cupido*). The "scatter-pattern" approach using 16- to 64-ha tracts for Greater Prairie Chicken management may not benefit Henslow's Sparrows if tracts are too small or too far from adjacent grasslands (Walk and Warner 1999). Conversely, some management uses for other species, such as light grazing for the dairy industry, may benefit Henslow's Sparrows. Grazing in the Finger Lakes National Forest in New York State has resulted in the scattered presence of Henslow's Sparrows throughout the region (Smith 1997 and references therein).

Even where isolated grasslands of sufficient size for breeding are present, regional paucity of large intact areas of habitat appears to account for absence of Henslow's Sparrows in certain locations. This could explain their absence at apparently suitable small sites in Vermont at the periphery of the range (Ellison 1992) and the presence of sparrows in a disjunct location having large regional grasslands such as northeastern Oklahoma (Reinking and Hendricks 1993).

The Partners in Flight "Bird Conservation Area" (BCA; described below) management plan employs a general approach that is well suited for breeding Henslow's Sparrows: use of large grassland plots within a matrix that is at least 40 percent grassland. More specifically, two factors appear to be paramount in making habitat desirable for Henslow's Sparrows: (1) for breeding birds, the size of a grassland must be over a threshold value of about 30 ha (Herkert 1998), unless large grasslands adjoin smaller sites (Mazur 1996) or the landscape is primarily grassland (Bajema and Lima 2001); and (2) for both wintering and breeding populations, grasslands must be maintained at a particular successional stage; particularly for breeding populations, grasslands must provide tall, dense vegetation, and litter. Managing for this outcome may use fire, grazing, or mowing, depending upon the region, timing, frequency, climate, and matrix in which the site is located (Pruitt 1996). Management regimes may need to vary by region or by habitat type.

Breeding Habitat

Regular disturbances are key to maintaining breeding grasslands for Henslow's Sparrows (Pruitt 1996). Often, a mosaic of disturbed and undisturbed habitats is recommended for grassland management (Herkert 1998 and references therein); however, light grazing may allow for constant levels of suitable disturbance throughout an entire habitat (Walk and Warner 2000). On private lands where burning is not as likely to be an option, haying, mowing, or light grazing may be desirable. Reinking *et al.* (in press) believed that grazing would maintain areas for nesting habitat while still allowing profitable use of private lands in Oklahoma.

At least three studies have compared different management regimes in the same areas. Walk and Warner (2000) compared burning, haying, grazing, and undisturbed regimes on warm- and cool-season grasslands in Illinois. They found that low-intensity grazing regimes consistently provided positive responses for all five prairie bird species studied. Undisturbed (within 12 months) warm-season grass and grazed (one year previous) warm-season grass fields ranked first and second, respectively, in abundance of Henslow's Sparrows. Skinner *et al.* (1984) in Missouri similarly found grazing to be the most versatile practice for a number of grassland species; lightly grazed or idle grasslands had the most sightings for Henslow's Sparrows. Also in Missouri, Swengel (1996) found that hayed sites had more Henslow's Sparrows than burned sites. In the same region, Winter (1998) found no overall difference in mean sparrow densities between

burned and hayed prairies. She found no difference in sparrows densities 1 and 2 years after burning, but found that sparrow densities increased between 1 and 2 years after haying.

Generally, management that produces tall grassy vegetation (>30 cm) from May to August should be considered (Smith 1992). If a location is to be managed by mowing or burning, the entire area used by sparrows should never be mowed, burned, or otherwise disturbed in one breeding season. Rather, a rotational disturbance regime should be maintained, wherein sections of an area are managed and others are left fallow (Herkert 1998 and references therein).

Removal of Tree Lines

Breeding Henslow's Sparrows respond best to larger areas of grassland within a large grassland matrix and may use even small patches if they adjoin larger grassland areas (T. McCoy, pers. comm.; Mazur 1996). Removal of tree lines, fencelines, and hedgerows between adjoining grassland plots may increase occupancy of smaller patches by sparrows (O'Leary and Nyberg 2000). However, removal of tree lines and hedgerows should be weighed against management considerations for other species and used where Henslow's Sparrows are the management priority. Other bird species of management concern may use such features for nest sites, song perches, or hunting perches.

Burning

Henslow's Sparrows tend to avoid recently burned areas (Herkert 1994a, Herkert and Glass 1999, Mangun and Kolb 2000, Swengel 1996, Zimmerman 1988) although sparrows have been noted occupying wet grasslands the summer after a spring burn (Pruitt 1996 and references therein). In Indiana, sparrows moved into fields in August and September following spring burns of the year. Productive fields following spring fires produced thick grass clumps by the end of the growing season and appeared to be structurally similar to fields birds used one year following a spring burn (J. Robb, pers. comm.). M. Winter (pers. comm.) also found sparrows using green grass clumps in July in units burned previously during the same growing season.

Burning may not always control woody encroachment; in the Big Oaks National Wildlife Refuge in Indiana, black locust invasion has not been adequately controlled by burning (J. Lewis, pers. comm.).

Sparrows generally start to reoccupy grasslands during the second growing season after a burn, may climax in numbers by the third year (Herkert 1994a), and decline thereafter. Cully and Michaels (2000) and Reinking *et al.* (in press) found that most sparrows selected sites that were burned 2 or 3 years previous to the current breeding season.

Prescribed burns should be conducted in early spring (March to early April) or late fall (October-November; Herkert 1998 and references therein). Herkert and Glass (1999) recommended caution when applying burns to small prairies containing sparrows. In one case, all 12 territories documented within a unit were eliminated the year after a 19-ha burn (Minney 1994). Herkert (1994a) recommended that 20-30 percent of the area of prairie fragments >80 ha be burned in rotation annually; on smaller prairies larger compartments may be burned, but should not total 50-60 percent of the prairie area. Even smaller sites may retain birds if only partially burned; Clawson (1991) noted that when almost half of a 56-ha Missouri prairie was burned, the same total number of sparrows was found as in the previous year when it was unburned; but all occupied the unburned portion. Herkert and Glass (1999) found that birds colonized adjacent areas unburned portions of prairie after prescribed fire.

Mowing and Haying

Mowing or haying at the proper time of year may maintain high numbers of sparrows; however, frequent mowing of suitable habitat may harm populations of nesting birds if it attracts them but is frequently disturbed by continued mowing (Rodenhouse *et al.* 1995). Austen *et al.* (1997 and references therein) suggested use of "sloppy mowing" wherein patches of standing vegetation are left, and recommended use of a brush hog. As with burning, leaving a portion unmowed may be desirable to retain breeding birds the season following mowing (M. Winter, pers. comm.).

Mowing or haying should take place after birds have largely finished breeding, the timing of which is likely to vary by location. Sample (cited in Pruitt 1996) recommended delaying haying until the middle or end of July. However, Winter (1999) noted nest initiations occurring into mid-July in Missouri; Reinking and coworkers have found active Henslow's Sparrow nests in mid-August in Oklahoma (Reinking and Hendricks 1993; Reinking *et al.*, in press); Kibbe and Laughlin (1985 and references therein) noted two nests from the laying stage in early Vermont records mowed in August; and Robb had nests fledging in mid-September in Indiana (J. Robb, pers. comm.). Ideally, Henslow's Sparrows should not be disturbed at least until after August (Smith 1992). Mowing in August or September will permit time for vegetative regrowth so that birds will use sites the following spring, whereas spring mowing will likely make sites unsuitable immediately afterwards (M. Winter, pers. comm.).

Mitchell *et al.* (2000) and Swengel (1996) indicated that mowing or haying might be preferable to burning; Mangun and Kolb (2000) recommended delayed summer mowing as the preferred management regime for sites in North Carolina. In southwestern Missouri prairies, hayed sites had more Henslow's Sparrows than burned sites within any of the field age classes examined (Swengel 1996). Highest sparrow abundances were in prairies >1.5 years after haying (Swengel 1996), but sparrows occupied sites the first growing season after haying.

Grazing

As with other disturbances, grazing regimes need to allow residual standing dead vegetation and maintain litter depth. In many areas, moderate to light grazing creates sufficient disturbance to maintain birds on a yearly basis. Skinner (1984) found that grazing created uneven cover and recommended light grazing resulting in 40 percent combined grass and forb cover for Henslow's Sparrows. As with other disturbance practices, rotating implementation among plots may be desirable, depending on the intensity of grazing. In Wisconsin, occurrence and abundance of Henslow's Sparrow was higher in rotationally grazed pastures compared to ungrazed and continuously grazed pastures (Temple *et al.* 1999).

In central Missouri grasslands managed by the Forest Service, livestock are used to control fescue and serecia lespedeza (*Lespedeza cuneata*) and encourage warm-season grasses by intensive grazing in two bouts of 15-20 days in April and the fall (S. Herndon, pers. comm.).

Effects of grazing may vary with region, presumably due to vegetative growth and climate. In Kansas, Zimmerman (1988) found that moderate grazing removed enough dead vegetation to reduce habitat suitability the year following grazing; but Smith (1997) found that birds were present in grazed and ungrazed pastures the year following mowing in New York, which has greater annual rainfall and presumably greater vegetative growth. In reclaimed strip mines in Indiana, sparrows avoided patches after light-moderate grazing (Bajema *et al.* 2001; S.L. Lima, pers. comm.). In a 1999 survey of pastures in the Finger Lakes region of New York known to have breeding sparrows (Smith 1997), C.R. Smith (pers. comm.) did not find any sparrows on active pastures, but found several on fields that had been fallow for ≥10 years. Severe droughts occurred in New York State in 1998 and 1999, suggesting that under extraordinary climate conditions, even modest grazing pressure may not allow maintenance of populations (C.R. Smith, pers. comm.).

Mitchell *et al.* (2000 and references therein) recommended that productive sites with dense grasses should be grazed to no more than 60 percent of aboveground vegetation. Smith (1997) indicated that a stocking rate of 0.12-0.24 head of cattle/ha allowed vegetation to grow at the proper rate in New York. Heavy grazing is not appropriate for Henslow's Sparrows due to severe changes in vegetation structure, but Reinking *et al.* (in press) believed that lighter levels of grazing were compatible both with management and economic use of the land.

Winter Habitat Management

To date, fewer studies have been published on habitat management regimes for wintering Henslow's Sparrows compared to those on breeding sparrows; little is known about effects of mowing or grazing on wintering sparrow abundances (Pruitt

1996). Henslow's Sparrows use grassy habitats during winter, but habitat area requirements are generally less stringent than those for breeding habitats (see previous sections). However, as with breeding habitat, frequent disturbance is required to maintain desirability of grassland habitat for Henslow's Sparrows (Pruitt 1996).

Fire was historically an important component of the longleaf pine/wiregrass ecosystem that the Henslow's Sparrow occupies in much of its winter range (Plentovich *et al.* 1999, Pruitt 1996). As with fires on breeding locations, winter burns exclude the sparrows from burn-disturbed areas immediately following treatment, while improving wintering habitat in the longer term (McNair 1998, Plentovich *et al.* 1998). Plentovich *et al.* (1999) suggested frequent fire to "maintain a mosaic of early successional habitats dominated by herbaceous vegetation."

M. Woodrey and coworkers (pers. comm.) found that Mississippi wintering sites managed with "winter" burns (conducted in the autumn) did not produce suitable habitat for Henslow's Sparrows immediately following burning, but were heavily used the next year. Numbers decreased second year post-burn and sparrows were virtually gone by the third year after the burn. However, spring burns (conducted April-May) allowed growing time for summer grasses, which set seed during fall. Preliminary evidence at these sites suggests that densities of Henslow's Sparrows the same year following spring burns are higher than densities one year after winter burns (M. Woodrey, pers. comm.). Grass seed is abundant the winter immediately following spring burns, whereas it is consumed by fire during winter burns of the same year.

W.D. Robinson and coworkers (pers. comm.) working at the Blackwater River State Forest, Florida, and the Conecuh National Forest, Alabama, found that Henslow's Sparrow reached maximum abundance in bogs within longleaf pine forests that had been burned the preceding winter. They found few or no birds in bogs that had been burned two or three winters earlier. Henslow's Sparrows also occupied bogs 1, 2, and 3 years after summer burns, with highest densities the first year after a summer burn. However, Robinson (pers. comm.) found that the highest abundance after summer burns was half that of the first year (approximately 1-1/2 years) after winter burns. They found that abundance of grass seed was the best predictor of sparrow abundance, and that grass seed was most abundant one year after a winter burn.

In southeastern Georgia, Henslow's Sparrows are present in powerline rights-of-way maintained through fire, herbicide, and mowing (C.R. Chandler, pers. comm.).

Other Management Considerations and Opportunities

Pruitt (1996) stressed the value of managing for Henslow's Sparrow in the context of managing for other grassland birds and grasslands in general, which are among the most endangered ecosystems (Samson and Knopf 1994). Many of the studies contributing to the literature on Henslow's Sparrows were studies on larger grassland bird communities (e.g., Herkert 1994a,b; Swengel 1996; Swengel and Swengel 1999; Walk and Warner 1999, 2000; Wiens 1969; Winter and Faaborg 1999).

Henslow's Sparrows typically have narrower habitat needs than other species nesting in the same habitats; Henslow's Sparrows usually require larger habitat tracts (e.g., Smith and Smith 1992) and taller and more dense vegetation than most other species nesting in an area. It appears clear that large (>100 ha) contiguous grasslands are preferable for grassland species in general and Henslow's Sparrows in particular (Herkert 1994b, Walk and Warner 1999). Management for Henslow's Sparrows may benefit other prairie birds, as in New York State, where Smith (1997) indicated that management for Henslow's Sparrows would also sustain Grasshopper Sparrow (*A. savannarum*) populations. Savannah Sparrows (*Passerculus sandwichensis*) and Boblink (*Dolichonyx oryzivorus*) also use habitats managed for Henslow's Sparrows (Mitchell *et al.* 2000, Peterson 1983). In Florida, wintering Swamp Sparrows (*Melospiza georgiana*) used the same habitat as wintering Henslow's Sparrows (Legare *et al.* 2000).

Management that is geared toward Henslow's Sparrows may not always be ideal for other prairie birds. Swengel (1996) stated that "management that favours Henslow's Sparrows is likely to be adequate but not optimal for Grasshopper Sparrows and Dickcissels" (*Spiza americana*), but added that Henslow's Sparrows should receive management priority because they are far less abundant than the other two species.

Whereas Henslow's Sparrows do not use prairies until 2-3 years post-burn, some prairie birds, such as Grasshopper Sparrow and Upland Sandpipers (*Bartramia longicauda*), appear to favor recently burned prairies (Herkert 1994a). It has been suggested that management policies favoring burning should provide a "mosaic" of habitat types and ages, and be managed by rotational burning to provide a variety of habitats in any year. However, as mentioned previously, two studies comparing grazing and other management regimes found that light grazing throughout the entire management area favored all passerines (Skinner *et al.* 1984, Walk and Warner 2000), although Walk and Warner (2000) indicated that retaining recently burned portions may be desirable for some non-passerines.

Conservation for Henslow's Sparrow habitat may be relevant to organisms other than birds. In a study comparing the co-occurrences of prairie birds and butterflies, Swengel and Swengel (1999 and references therein) found that Henslow's Sparrow presence was a better predictor of Regal Fritillary (*Speyeria idalia*) presence than the "direct study of the butterfly's floristic associations and regional trends." In southern longleaf pine habitat, fire is important for maintaining other rare animals and plants as well as wintering Henslow's Sparrows (D.B. McNair, pers. comm.; Pruitt 1996).

Monitoring Effects of Management Activities

As previously mentioned, several papers have been written comparing different management regimes on the breeding ground, and several studies on wintering habitat are in progress. Continued monitoring of management practices for both habitats is still of value, as is monitoring the influence of CRP land use.

Past and Current Conservation Activities Undertaken to Benefit the Species

Recent Research

Recent research activities directed at conservation have been mentioned previously in this document in the State summaries. Other recent research, including surveys and population information, include:

Iowa and Michigan

Koford (1999) recently surveyed populations in Iowa, Ohio, Indiana, and Michigan. In addition to the counts mentioned in the statewide summaries (above), he found 27 sparrows in 8 of 98 fields surveyed in Michigan. Including sparrows detected incidentally in other field work, a total of 103 individuals were detected in 16 Michigan counties (Koford 1999). Henslow's Sparrows were also widely distributed in southern Iowa in discrete patches of appropriate habitat (idle fields). Southern Iowa appears to be the core of the recent range in Iowa, although sparrows are occasionally detected throughout the State, often on prairie remnants or large fields of planted cover (R. Koford, pers. comm.; Koford 1999).

Kentucky and Tennessee

Monroe and Richardson recently examined nest-site characteristics and nesting success for 37 nests located on two reclaimed strip mines and two unmined areas in Taylor and Muhlenberg Counties for four populations in Kentucky (M. Monroe, pers. comm.).

E.D. Moss is documenting reproductive success and developing monitoring and management strategies at Fort Campbell on the Tennessee-Kentucky State line and at Fort McCoy in Wisconsin. He found 49 Henslow's Sparrow nests in 1999 and 2000 at the Fort Campbell site (E.D. Moss, pers. comm.). Moss and coworkers flagged approximately 60 territories in 1999 and 130 territories in 2000 before stopping to focus on nest research.

Oklahoma

Reinking *et al.* (in press) have documented a population of up to 3,000 singing males in breeding habitat on The Nature Conservancy's Tallgrass Prairie Preserve in northeastern Oklahoma. Surveys in eight northeastern Oklahoma counties found sparrows at 28 sites in six counties; Breeding Bird Atlas workers documented Henslow's Sparrows in three additional counties (Reinking *et al.*, in press).

North Carolina

Mangun and Kolb (2000) recently published a study on habitat management for Henslow's Sparrows breeding in meadows at the Voice of America broadcasting site, and they estimated the population to be about 200 pairs (Mangun and Kolb 2000 and references therein).

Wintering Populations

As mentioned above, W.D. Robinson (pers. comm.) and coworkers are studying wintering habitat use and burn frequency in "seepage bogs" in the Blackwater State Forest, Florida, and the Conecuh National Forest, Alabama. M. Woodrey (pers. comm.) and coworkers are studying winter habitat use and diet at the Mississippi Sandhill Crane National Wildlife Refuge. They are also using radio transmitters to study movement and winter site fidelity.

Estimates of wintering populations for the above sites are difficult, but they appear to contain substantial numbers of wintering birds, as does the Apalachicola National Forest in Florida (D.B. McNair, pers. comm.). A population at Fort Polk, Louisisana, may contain 500-1,000 wintering birds (S. Ibargüen, pers. comm.). M. Woodrey (pers. comm.) estimates that the States of Alabama, Louisiana, Mississippi, Florida, and Georgia contain the bulk of the wintering Henslow's Sparrow population, with the remaining birds in Texas.

Canada

A National Recovery Plan for Henslow's Sparrow by Austen *et al.* was completed in 1997. The report documents the recent status of the species throughout Canada, including reports from surveys conducted during the late 1980s-1990s. An implementation plan included a timetable for research, management, and monitoring to year 2002.

Partners in Flight

Partners In Flight (PIF) is a partnership begun in 1990 among governmental agencies, non-governmental organizations, and others to emphasize the conservation of birds not covered by existing conservation initiatives. In 1995, PIF began a plan to conserve all nongame landbirds in the United States through a species prioritization process (Carter *et al.* 2000).

Prioritization Plans for every species were recently completed for each physiographic area and/or State in the United States as the foundation for a scientifically based long-term strategy for bird conservation (Pashley *et al.* 2000). Physiographic areas are based upon the Breeding Bird Survey's original physiographic strata (Robbins *et al.* 1986). Seven parameters for prioritization include: breeding distribution, nonbreeding distribution, relative abundance, threats to breeding, threats to nonbreeding, population trend, and area importance (for a detailed description of parameters and score criteria, see Carter *et al.* 2000). Scores are summed to produce a composite score from 7 to 35, with species having the highest scores considered the most vulnerable. Henslow's Sparrow has a Species Prioritization Process score of 24 on the Partners in Flight Watch List (scores of 23 or higher are in the highest priority category; Pashley *et al.* 2000).

In areas containing grassland birds, Partners in Flight recommends a Bird Conservation Area (BCA) "based upon general principles of grassland bird ecology as described by Sample and Mossman (1997)" and a general understanding of the habitat needs of "high priority grassland-nesting passerines at both the patch and landscape scale" (Fitzgerald *et al.* 2000a,b,c; Fitzgerald and Pashley 2000). This model employs a 4,000-ha management unit with an 800-ha block of grassland as the "core" (centered on a habitat of a focal species). Grassland tracts of 40 ha or larger are in a matrix of at least 800 ha of grassland (at least 40 percent of the area), managed through burning or light grazing (Fitzgerald *et al.* 2000a,b,c). The strategy is currently being tested at the Northern Prairie Wildlife Research Center at Jamestown, North Dakota (Winter *et al.* 2000).

Surveys, Monitoring, and Research Needs

Unlike some migratory species for which wintering or breeding data are difficult or impossible to obtain, it is within our grasp to gather the information necessary to monitor and conserve Henslow's Sparrow populations reliably for the future. Further research is needed on demography, reproduction, and response to management across a variety of habitat sizes and regions; research is also needed on wintering site fidelity, survival, and habitat use and management. In consort with long-term population breeding and wintering surveys (below), knowledge in these areas would solidify our understanding of the factors affecting sparrow populations.

Surveys

Henslow's Sparrows are generally difficult to detect with singing surveys. Bajema *et al.* (2001) indicated that the true number of singing males was on average 64-68 percent higher than suggested by surveys.

Because this species is inadequately sampled by BBS (B. Peterjohn, pers. comm.; Fitzgerald *et al.* 2000; Pruitt 1996), surveys designed specifically to monitor breeding Henslow's Sparrow should be considered. Pruitt (1996) suggested that such a survey should account for the ephemeral nature of Henslow's Sparrow habitat. Yearly or bi-yearly surveys employing standardized methodologies using properly trained personnel located over a range of the species' occurrence could allow for better detection of population trends. Such surveys take place now in certain breeding areas, but efforts are not coordinated at the larger scales necessary to determine population changes.

A model of such a survey exists in the Cerulean Warbler Atlas Project administered by The Cornell Laboratory of Ornithology (Barker and Rosenberg 1998, Rosenberg *et al.* 2000). This study engaged volunteers and professional biologists to survey known and potential breeding sites of Cerulean Warblers (*Dendroica cerulea*) from late May through July. Like Henslow's Sparrow habitat, Cerulean Warbler breeding habitat is not adequately covered by present BBS routes. Unlike Cerulean Warbler, a similar project for Henslow's Sparrows would need to consider the changing nature of Henslow's Sparrow habitat. It nevertheless remains possible to design a wide-ranging survey that quantifies changes in abundances at sites over time while considering habitat succession. At the same time, such a survey would need to explore and incorporate potential new breeding sites as they become available. Such an undertaking is large but not beyond the scope of similar programs that focus on single or few species and use amateur help, including several projects currently managed by The Cornell Laboratory of Ornithology.

Wintering surveys would be of value as well. Several managed wintering areas having consistently large Henslow's Sparrow populations (Conecuh National Forest, Alabama; Apalachicola National Forest and Blackwater State Forest, Florida; Fort Polk, Louisiana; and Mississippi Sandhill Crane National Wildlife Refuge) offer potential sites for regular winter surveys.

Both breeding and wintering surveys need to consider who owns and manages used areas and whether these areas will continue to provide habitat. Continued surveys of CRP land would be of value, as would efforts to monitor succession of lands under CRP.

Research Needs

Much recent research has expanded our knowledge of Henslow's Sparrows on both winter and summer habitats; research on the breeding grounds has greatly expanded our knowledge about breeding populations, nesting success, and habitat use. However, to obtain an accurate picture of the factors influencing Henslow's Sparrow populations and habitat use, further research is needed.

High Priority Activities

Breeding Research and Demography

Despite the occurrence of a number of new breeding studies, there are still not enough data to determine whether breeding Henslow's Sparrow populations are reproducing sustainably. Yearly information is needed on daily nest survival and mortality estimates over a range of locations and tract sizes. Although large populations in large contiguous grasslands exist, the contribution of numerous small populations in areas such as north-central Missouri and southern Illinois also needs to be assessed. This will further determine the importance of fragment size, landscape effects, and yearly variability on nesting success and the implication of these effects on population viability. Medium- to long-term nesting studies at a variety of locations over a range of tract sizes and latitudes would provide an invaluable picture of the role of demography and fragmentation in population viability. Better knowledge of background rates of reproduction would provide prospective for the contribution of breeding and wintering habitat loss and winter survivorship on overall population stability.

Ideally, demographic data would be derived directly from nesting studies. However, because Henslow's Sparrow nests are especially difficult to find, a possible alternative would be to create a reproductive index using a range of breeding behaviors, such as adult distraction displays and feeding visits by adults to nest areas. Vickery *et al.* (1992) successfully used such a composite of breeding behaviors in a study of several grassland species. For Henslow's Sparrows, the ranks of reproductive indices could be compared among different geographic locations and used to identify habitat features related to reproductive success.

Breeding Habitat Management and Habitat Succession

Although fire, grazing, or haying and mowing all maintain habitat for Henslow's Sparrows, there is still debate about which method is most appropriate. The relative rarity of habitat and differing ownership patterns make it difficult to design replicated studies in which treatments are randomly assigned; in addition, regional or climatic differences may alter findings between sites. A study that replicates consistent management treatments across several regions over a period of years could provide valuable information about management regimes and their interactions with regional factors.

Reclaimed strip mines have provided some large grassland reserves for Henslow's Sparrow populations. Although reclaimed mine areas in Indiana showed little signs of succession (S.L. Lima, unpublished data), further research into the nature of succession on former strip-mined habitats would indicate whether management practices are needed to prolong habitat desirability in strip mines.

Location and Size of Populations

As with nesting data, advances have also been made in locating previously unknown large breeding populations, particularly at military installations and reclaimed strip mines. Further research is needed to determine whether other significant large breeding populations exist. In addition, regions such as north-central Missouri and southern Illinois appear to support numerous scattered small breeding populations, whose contribution to the overall breeding Henslow's Sparrow population needs to be assessed in conjunction with population-specific data on nest productivity (above).

Winter Population Estimates, Survivorship, Site Fidelity, Management, and Habitat Use

Although we know that much Henslow's Sparrow breeding habitat has been lost, the relative contributions of breeding and wintering habitat availability to population declines are not clear. Overwinter survival is hard to determine due to infrequency of recaptures and possible movement of individuals between sites, but proposed radiotelemetry studies may shed light in this area (M. Woodrey, pers. comm.). Further knowledge about range of habitats and tract sizes used by Henslow's Sparrows in winter and their level of occupancy would be instructive. As previously mentioned, management studies are currently underway in at least two large wintering habitats; such studies should be continued and expanded to include additional locations. Population estimates for wintering areas would be of value as well.

Medium Priority Activities

Post-breeding Habitat Use

Studies by Reinking *et al.* (in press) suggest that Henslow's Sparrows use habitats after breeding that are not suitable during nesting. Such areas may have been avoided during breeding because they were not sufficiently vegetated (Reinking *et al.*, in press), but could have been used later because of greater habitat flexibility after breeding. Studies of family and juvenile movements after breeding using radio-tagged birds would determine the range and importance of post-breeding habitats used. Similar studies on forest birds (e.g., Anders *et al.* 1998) indicated that some species use a wider variety of habitats after breeding than during.

Migration Habitat Use

Very little is known about Henslow's Sparrow use of habitats during migration. The secretive nature of Henslow's Sparrows likely explains the paucity of reported migration sightings; this may be compounded by absence of singing or other territorial behaviors during migration. Surveys of potential grassland or other habitats that Henslow's Sparrows use during migration, especially those outside of breeding and wintering ranges, would provide a picture of habitat flexibility. Data on migratory habitat use would determine whether it is important to maintain these habitats throughout migration routes.

Low Priority Activities

Determination of Subspecies Status and Genetic Structure of Populations

It remains unclear whether the eastern subspecies *A. Henslowii susurrans* exists or ever existed (Pruitt 1996; P. Vickery, pers. comm.). Studies using morphometric and molecular methods on museum and live specimens could be undertaken to determine what the putative subspecies and statuses are (P. Vickery, pers. comm.) and whether special conservation efforts need to be undertaken to preserve certain populations.

A project is under way to link breeding and wintering Henslow's Sparrow populations using genetic markers (S. Ibargüen, pers. comm.). Depending on the degree of mixing on either end, such a project would allow the identification of vulnerable populations and the targeting of habitats on either end for management. The project would also allow the determination of genetically distinct breeding populations. Identification of special populations could make conservation of these populations a high priority if special action is warranted based on genetic differences and vulnerability of habitats.

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2002. **Conservation assessment: Henslow's Sparrow *Ammodramus henslowii***. Gen. Tech. Rep. NC-226. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 46 p.

Addresses range, distribution, natural history, population trends, threats, management and protection for Henslow's Sparrow (*Ammodramus henslowii*). Summarizes recent data on nesting success and newly discovered populations.

KEY WORDS: Henslow's Sparrow, *Ammodramus henslowii*, prairie, grassland songbird, conservation.

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